Victoria Field:
Decommissioning Environmental Appraisal

NEO-VC-OP-PLN-0002

Rev: 01

In 2019 Verus Petroleum underwent a name change to become NEO Energy. NEO accepts, agrees and supports previous studies and assessments carried out by Verus. Where appropriate there are references to Verus documentation published prior to this date.

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Definitions

Acronym	Definition
'	Minutes
"	Inches
"	Seconds
%	Percentage
°	Degrees
°C	Degrees celsius
£	Pound Sterling
3LPP	3-layer polypropylene
ACOPS	Advisory Committee on Protection of the Sea
AI	Asset Integrity
AIS	Automated Identification System
Al	Aluminium
API	American Petroleum Institute
BAT	Best available technique
BEIS/ OPRED	Department for Business, Energy and Industrial Strategy Offshore Petroleum Regulator for Environment and Decommissioning
BEP	Best Environmental Practice
BSI	British Standards Institute
BWM	Ballast Water Management
C	Carbon
CA	Comparative Assessment
CBD	Convention on Biological Diversity
CCS	Carbon capture and storage
Cd	Cadmium
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CH_3OH/MeOH	Methanol
CH_4	Methane
CHARM	Chemical Hazard Assessment and Risk management
Cl	Chlorine
cm	Centimetre
CO_2	Carbon dioxide
CoP	Cessation of Production
CMAPP	Corporate Major Accident Prevention Policy
CRA	Corrosion Resistant Alloys
cSAC	Candidate Special Area of Conservation
CSV	Construction Support Vessel
CtL	Consent to Locate
Cu	Copper
dB	Decibel
$dB_{ht\ (species)}$	Decibels above the hearing threshold of a species
DECC	The Department of Energy & Climate Change
Defra	Department of Environment, Food and Rural Affairs
DNV	Det Norske Veritas
DP	Decommissioning Programme
DSV	Dive Support Vessel

Acronym	Definition
DTI	Department of Trade and Industry
E	East
EA	Environment Agency
EA	Environmental Appraisal
EA	Energy Act
EC	European Commission
ED50	European Datum 1950
EEC	European Economic Community
EIA	Environmental Impact Assessment
ELD	Environmental Liability Directive 2004/35/EC
EMS	Environmental Management System
EPA	Environmental Protection Act
EPS	European Protected Species
ERL	Effects Range Low
EU	European Union
EUNIS	European Nature Information System
FDP	Field Development Plan
Fe	Iron
FEPA	Food and Environment Protection Act
FSU	Floating Storage Unit
Gj	Giga joule
GMSL	Global Marine Systems Limited
GRT	Gross Register Tonnage
h	Hour
HASS	High Activity Sealed Source
Hg	Mercury
HLV	Heavy Lift Vessel
HSE	Health, Safety and Environment
HSE	Health and Safety Executive
HSEMS	Health, Safety and Environmental Management System
HSEQ	Health, Safety and Environment and Quality
Hz	Hertz
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
In situ	On site
IoP	Institute of Petroleum
IOPP	International Oil Pollution Prevention
ISO	International Organization for Standardization
ITOPF	International Tanker Owners Pollution Federation Limited
JNCC	Joint Nature Conservation Committee
kg	Kilogram
kHz	Kilohertz
km	Kilometre
km^2	Squared kilometre
l	litre
LAT	Lowest Astronomical Tide
m	Metre

Acronym	Definition
m^2	Squared metre
m^3	Cubic metre
MALSF	Marine Aggregate Levy Sustainability Fund
MARPOL	The International Convention for the Prevention of Pollution from Ships
MCA	Maritime Coastguard Agency
MCAA	Marine and Coastal Access Act 2009
MCZ	Marine Conservation Zone
ml	Mililitre
mm	Millimetre
MMO	Marine Management Organisation
Mn	Manganese
MOD	Ministry of Defence
MPE	Ministry of Petroleum and Energy
MSA	Marine Scotland Act
MSDF	European Marine Strategy Framework Directive
N	North
Nb	Niobium
NCMPA	Nature Conservation Marine Protected Area
ND	No data available
NE	North East
NFFO	National Federation of Fishermen's Organisation
NGO	Non-Governmental Organisation
Ni	Nickel
NIEA	Northern Ireland Environment Agency
NMPI	National Marine Interactive Planning Tool
NNW	North North West
NO_x	Nitrous oxides
NORM	Naturally Occurring Radioactive Material
NRC	National Research Council
NW	North West
OBF	Oil-based drilling fluid
OCNS	Offshore Chemical Notification Scheme
OESEA	Offshore Energy Strategic Environmental Assessment
OGA	Oil and Gas Authority
OGP	Oil and Gas Producers
OGUK	Oil and Gas UK
OPEP	Oil Pollution Emergency Plan
OPF	Organic-phase drilling fluid
OPPC	Oil Pollution Prevention and Control
OPRC	Oil Pollution Preparedness, Response and Co-operation
OSCAR	Oil Spill Contingency and Response
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OSRL	Oil Spill Response Limited
P	Phosphorus
P&A	Plug and Abandonment
PA	Petroleum Act
PARCOM	Paris Commission

Acronym	Definition
Pb	Lead
PL	Pipeline
PLONOR	Pose little or no risk to the environment
POPA	Prevention of Oil Pollution Act 1971
PPD	Public Participation Directive
ppt	Parts per trillion
psi	Pounds per square inch
pSPA	Proposed Special Protection Area
PSV	Platform Support Vessel
rMCZ	Recommended Marine Conservation Zone
ROV	Remotely-operated vehicle
S	South
S	Sulphur
SAC	Special Area of Conservation
SBF	Synthetic-based drilling fluid
scf	Standard cubic feet
SCI	Site of Community Importance
SCOS	Special Committee on Seals
SE	South East
SEPA	Scottish Environment Protection Agency
Si	Silicon
sm^3	Standard cubic metre
SMRU	Sea Mammal Research Unit
SNS	Southern North Sea
SO_2	Sulphur dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabirds Oil Sensitivity Index
SOSREP	Secretary of State for Energy and Climate Change
SO_x	Sulphur oxides
SPA	Special Protected Area
SPL	Sound Pressure Level
SW	South West
TFSRWR	The Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008
THC	Total hydrocarbon concentration
Ti	Titanium
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKDMAP	United Kingdom Digital Atlas
UKHO	United Kingdom Hydrographical Office
UKOOA	United Kingdom Offshore Operators Association
UKOPP	UK Oil Pollution Prevention
UNCLOS	United Nations Convention on the Law of the Sea
UNECE	United Nations Economic Commission for Europe
UTM	Universal Transverse Mercator coordinate system
UV	Ultra Violet
V	Vanadium
NEO	NEO Energy

Acronym	Definition
VMS	Vessel Monitoring System
VOCs	Volatile organic compounds
W	West
WHPS	Wellhead protection structure
WSR	Regulation (EC) No 1013/2006 on shipments of waste
Zn	Zinc
µPa m	Micropascal metre

Glossary

Term	Definition
Acute toxicity	Any poisonous effect produced from a single or short exposure (24 to 96 hours) resulting in severe biological harm or death.
Algae	Any of various green, red, or brown organisms that grow mostly in water, ranging in size from single cells to large spreading seaweeds. Like plants, algae manufacture their own food through photosynthesis and release large amounts of oxygen into the atmosphere. They also fix large amounts of carbon, which would otherwise exist in the atmosphere as carbon dioxide. Algae form a major component of marine plankton and are often visible as pond scum and blooms in tidal pools.
Annex I	Legislation protecting certain habitats under the EC Habitats Directive.
Annex II	Legislation protecting certain organisms under the EC Habitats Directive.
Bathymetry	The measurement of water depth in oceans, sea and lakes.
Benthic Fauna/ Community	Organisms that live on, near, or in the bottom sediments of the seabed.
Benthos	See 'Benthic Fauna'.
Bioaccumulation	A general term of the accumulation of substances, such as organic chemicals in an organism or part of an organism.
Biogenic	A substance produced by life processes.
Bivalve	A class of marine and freshwater molluscs with laterally compressed bodies enclosed by a shell in two hinged parts.
Block	A North Sea acreage sub-division measuring approximately 10 km x 20 km forming part of a North Sea quadrant, e.g. Block 21/05 is the 5th block of Quadrant 21.
Chronic Toxicity	The development of adverse effects as a result of long term exposure to a contaminant or other stressor.
Condensate	Volatile liquid consisting of the heavier hydrocarbon fractions that condense out of the gas as it leaves the well, a mixture of pentanes and higher hydrocarbons.
Copepods	Small planktonic crustaceans that form a vital part of many marine food webs.
Crustaceans	A very large group of arthropods usually treated as a subphylum, which includes such animals as crabs, lobsters, crayfish, shrimp, krill and barnacles.
Cuttings	The small chips or flakes of rock retrieved from a well by the circulation of the mud.
Decommissioned in situ	Left in its current location
Decommissioning	Shutdown of the development with system cleaning and dismantling of facilities.
Demersal	living near, deposited on, or sinking to the bottom of the sea
Dinoflagellates	Any of numerous one-celled, aquatic organisms that have characteristics of both plants (algae) and animals (protozoans). Most are microscopic and marine. The group is an important link in the food chain. Dinoflagellates also produce part of the luminescence sometimes seen in the sea.
Echinoderm	Any marine invertebrate animal of the phylum Echinodermata, including starfishes and sea urchins, characterized by a five-part radially symmetrical body and a calcareous endoskeleton.
Ecosystem	The physical environment and associated organisms that interact in a given area. There is no defined size for an ecosystem.
Effects Range – Low (ERL)	Effects Range-Low (ERL) value is the lower tenth percentile of the data set of concentrations in sediments which were associated with biological effects.
Environmental Impact Assessment	A process to identify and assess the impacts associated with a particular activity, plan or project.
Environmental Management System	A formal system which ensures that a company has control of its environmental performance.

Term	Definition
Environmental Statement	A report setting out the findings of an assessment of a project's environmental impacts.
Epibenthic/ Epifauna	Organisms that live on the surface of sediments at the bottom of the sea.
European Commission	Body made up of commissioners from each EU country, responsible for representing the common European interest, with the power to instigate and apply changes in European law to all EU countries.
European Protected Species	Species that are listed in Annex IV of the Habitats Directive, and are therefore protected from harm or disturbance by European law.
Eutrophication	An enrichment by or excess of nutrients to the water, which may result in an explosive growth of algae
Fauna	Animal life.
Flora	Plant life.
Frond mats	Mattress with buoyant fronds attached installed to reduce scour.
Greenhouse gas	Gas that contributes to the greenhouse effect. Includes gases such as carbon dioxide (CO2) and methane (CH4). The greenhouse effect results in a rise in temperature due to incoming solar radiation being trapped by carbon dioxide and water vapour in the Earth's atmosphere.
Halogens	Any of a group of five non-metallic elements with similar properties. The halogens are fluorine, chlorine, bromine, iodine, and astatine
Hazardous Waste	Hazardous Waste is a term used in England, Wales and Northern Ireland for materials that have one or more of the hazardous properties described in the Hazardous Waste Directive 91/689/EEC.
Hydroids	Hydroids are a life stage for most animals of the class Hydrozoa, small predators related to jellyfish
Infauna	Fauna that lives within sediments.
Inorganic	Not having the structure or characteristics of living matter (not considered organic).
Macrofauna	Benthic or soil organisms which are larger than 0.5mm.
Marine Scotland	A government consultee and a lead marine management organisation in Scotland, bringing together the functions of Marine Scotland Science, Marine Scotland Compliance and the Scottish Government Marine Directorate.
Mattresses	A structure to support, protect and provide stability to pipelines and to give any additional dropped object protection.
Megaripples	Large, sand waves or ripple-like features having wavelengths greater than 1 meter or a ripple height greater than 10 centimetres
Molluscs	Large phylum of invertebrate animals including snails, slugs, mussels, and octopuses.
Organic	Compounds containing carbon and hydrogen.
OSPAR	OSPAR is the mechanism by which 15 Governments & the EU cooperate to protect the marine environment of the North-East Atlantic.
P&A (Plug and Abandonment)	To seal a well, or part of a well with cement before leaving the well permanently sealed and abandoned.
Pelagic	Any water in the sea that is not close to the bottom or near to the shore. Marine animals that live in the water column of coastal, ocean and lake waters, but not on the bottom of the sea or the lake.
Phytoplankton	Planktonic organisms that obtain energy through photosynthesis.
PLONOR List	The OSPAR List of Substances/ Preparations Used and Discharged Offshore which are Considered to Pose Little or No Risk to the Environment (PLONOR) contains substances whose use and discharge offshore are subject to expert judgement by the competent national authorities or do not need to be strongly regulated.

Term	Definition
Polychaete	A class of marine annelid worms.
Protozoan	Any of a large group of one-celled organisms (called protists) that live in water or as parasites.
Risk	The combination of the probability of an event and a measure of the consequence.
Salinity	The dissolved salt content of a body of water.
Sound	Sound is a mechanical wave that is an oscillation of pressure transmitted through a solid, liquid, or gas, composed of frequencies within the range of hearing and of a level sufficiently strong to be heard.
Stratification	Separation of a body of water into two or more distinct layers due to differences in density or temperature.
Surge	A rise in water level above that expected due to tidal effects alone; the primary causes are wind action and low atmospheric pressure.
Taxa	Categories in the biological classification system for all living organisms (i.e. kingdom, phylum, class, order, family, genus, species).
THC	Total Hydrocarbon Concentration. The summed concentration of all the resolved/unresolved (i.e. UCM) aliphatic and aromatic hydrocarbons derived from biogenic and petrogenic sources. A petrogenic hydrocarbon is one produced by the incomplete combustion of petroleum.
Thermocline	An area in the water column where there is a rapid temperature change with increasing depth. This is due to stratification between warmer, well mixed, less dense water in the surface layer and deeper, colder water below.
UKCS	Areas of the United Kingdom Continental Shelf waters in which the UK Government has jurisdiction over oil and gas activity.
Water column	A theoretical column through a body of water from the surface to the sediments. This concept can be helpful when considering the different processes that occur at different depths.
Zooplankton	Broadly defined as heterotrophic (deriving energy from organic matter) planktonic organisms, although some protozoan zooplankton species can derive some energy from sunlight.

0 Non-Technical Summary

NEO Energy (NEO) ceased production from the Victoria Field, situated in United Kingdom Continental Shelf (UKCS) Block 49/17a of the southern North Sea (Figure i) in January 2016 and is preparing two decommissioning programmes (DPs):

1. Decommissioning of the Victoria Field Installation (DP1); and
2. Decommissioning of the Victoria Pipeline and Umbilical (DP2)

This environmental appraisal (EA) presents the findings of the environmental impact assessment undertaken in support of the Victoria decommissioning programs. The purpose of the environmental impact assessment is to understand and communicate the potential significant environmental impacts associated with the project and to inform the decision-making process.

This section of the document forms the non-technical summary, which provides an overview of the environmental impact assessment.

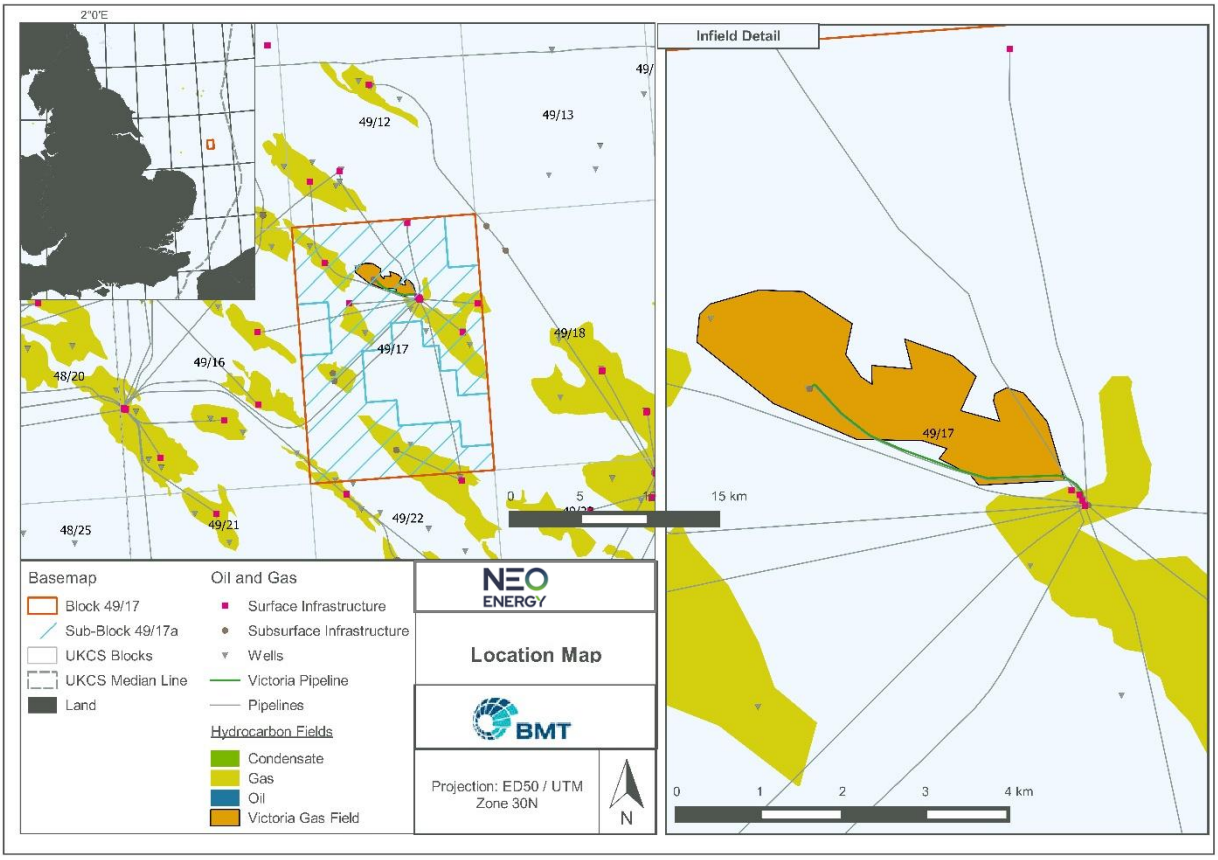


Figure i: Location map of the Victoria Field infrastructure

0.1 Project Overview

The Victoria Field was discovered in January 2007 by Silverstone Energy. The exploration well, 49/17-14, was subsequently plugged and abandoned. A Field Development Plan (FDP) was submitted and approved in 2007. Appraisal well 49/17-14a was completed as a vertical and hydraulically fractured production well in August 2008. As part of the FDP, the Victoria Field was developed as a subsea tie-back to the Chrysaor owned Viking BD platform, some 3.8 km away. Production commenced in October 2008, with gas being exported to the Theddlethorpe terminal via the Chrysaor operated Viking B complex. Cessation of Production (CoP) was approved (and occurred) in January 2016. Offshore decommissioning activities are expected to commence in 2022, but opportunities will be looked at to commence earlier if possible.

0.2 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 and the Energy Act 2016. 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 (BEIS) before the owners of an offshore installation or pipeline may proceed with decommissioning.

There is presently no statutory requirement to prepare an Environmental Statement for decommissioning. However, under the Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 (OPRED, 2018), to inform the DP process an Environmental Impact Assessment (EIA) must be documented in an EA, which should be submitted along with the DP and any Comparative Assessment (CA).

0.3 Scope of Victoria Decommissioning Programme

The Victoria infrastructure to be decommissioned under the two programmes are as follows.

DP1 infrastructure:

- Horizontal tree, wellhead and protective structure
- Victoria valve skid; and
- Concrete mattresses and grout bags

DP2 pipeline and umbilical consist of:

- Tree to valve skid spool
- Tree to valve skid controls jumper (27 m)
- Valve skid to main pipeline 6 spool (two sections) (126 m)
- Umbilical at Victoria valve skid (150 m)
- Pipeline crossing over Viking AR 24”/3” lines (174 m)
- Umbilical crossing over Viking AR 24”/3” lines, (144 m)
- Pipeline to Viking BD valve skid spools (78 m)
- Umbilical at Viking BD valve skid (120 m)
- 3.95 km (approximately) 6” carbon steel production pipeline; and
- 3.95 km controls and chemical injection umbilical

0.4 Recommended Decommissioning Options

As required under the Petroleum Act 1998, NEO has conducted a CA where five options were considered for the decommissioning of Victoria pipeline and umbilical and six flushing options for flooding and degassing the pipeline. It has been determined that the most viable decommissioning option for the pipeline and umbilical would be to leave them in situ with removal of the pipeline ends.

Of the technically feasible pipeline flushing options, the CA determined that the preferred option would be to use a vessel to vent the pipeline to sea at the Victoria valve manifold, allowing free flood from Victoria. This is then followed by the relocation of the vessel to Viking BD skid and flushing the remaining contents to sea.

0.5 Environmental Settings and Sensitivities

A key consideration when planning and finalising the Victoria decommissioning programme is to give a clear understanding of the surrounding environment. This section provides an overview of the physical, biological (Tables i and ii) and socioeconomic environment (Table iii) both within the United Kingdom Continental Shelf Block 49/17a (the block of interest), and in the wider southern North Sea area.

Table i. Key environmental characteristics and sensitivities within the vicinity of the Victoria Field

Aspect	Characteristics
Site overview	The Victoria Field infrastructure is located within Block 49/17a, approximately 87 km northeast of the nearest United Kingdom landfall, in North Norfolk, and approximately 45 km to the west of the United Kingdom/ Netherlands median line. The water depth at the Victoria Field varies between approximately 21 and 27 m Lowest Astronomical Tide (LAT).
Conservation interests	
Annex I habitats	The Victoria subsea infrastructure is located within the North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (SAC). Annex I habitats occurring within this SAC include "sandbanks that are slightly covered by seawater all the time" that radiate northeast parallel to the Norfolk coast. Also present are Annex I biogenic reef habitats formed by the polychaete worm *Sabellaria spinulosa*. Recent surveys investigating the presence of *S. spinulosa* in Block 49/17a and surrounding areas did not observe evidence of *S. spinulosa* "reef habitat".
Annex II species	All four Annex II 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 Quadrant 49 and surrounding quadrants.
Marine protected areas	
North Norfolk Sandbanks and Saturn Reef SAC	Victoria subsea infrastructure located within this SAC.
Southern North Sea cSAC	Victoria subsea infrastructure located within this SAC.
Plankton	
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	The sediments in Block 49/17a are classified as very poorly to moderately well sorted, fine sand to fine gravel with low content of silt/ clay and organic matter.
Benthic fauna	The macrofauna throughout the Victoria survey were typical for the general area and associated with the sediment composition and water depth across the survey area. The infaunal community was dominated by polychaetes, followed by crustaceans. Epifaunal communities are sparse. The small fragmented patches of *S. spinulosa* observed within the area do not constitute a reef

Aspect	Months of the year											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish spawning and nursery grounds in International Council for the Exploration of the Sea Rectangle 35F2												
Mackerel	N	N	N	N	N S*	N S*	N S*	NS	N	N	N	N
Herring	N	N	N	N	N	N	N	NS	NS	NS	N	N
Cod	NS	NS*	NS*	NS	N	N	N	N	N	N	N	N
Nephrops	NS	NS	NS	NS*	NS*	NS*	NS	NS	NS	NS	NS	NS
Tope shark	N	N	N	N	N	N	N	N	N	N	N	N
Whiting	N	NS	NS	NS	NS	NS	N	N	N	N	N	N
Plaice	S*	S*	S	-	-	-	-	-	-	-	-	S
Lemon sole	N	N	NS	NS	NS	NS	NS	NS	NS	N	N	N
Sole	-	-	S	S*	S	-	-	-	-	-	-	-
Sandeel	NS	NS	N	N	N	N	N	N	N	N	NS	NS
Sprat	N	N	N	N	NS*	NS*	NS	NS	N	N	N	N
Horse mackerel	-	-	S	S	S*	S*	S	S	-	-	-	-
Key:	S: spawning			S*: peak spawning			N: nursery			- No recorded presence		
Seabirds in block 49/17												
Seabirds sensitivity	ND	1	2	ND	ND	2	2	5	5	5	ND	1

Marine mammals Quadrant 49 and surrounding quadrants													
Minke whale							L	L					
Long-finned pilot whale								L					
Bottlenose dolphin											L		
Common dolphin		L											
White-beaked dolphin	M		M	VH	L	L	L			L	L	L	
White-sided dolphin								L					
Harbour porpoise		L	H	L	H	H	L	VH	H	L	M	L	

Seabirds sensitivity key:								
Sensitivity	Extremely high	1	High	3	Low	5	Sightings within quadrant 49	
	Very high	2	Medium	4	No sightings		Sightings in surrounding quadrants	

Cetacean abundance key:						
Cetacean abundance	Very high	VH	Moderate	M	No sightings/ no data	ND
	High	H	Low	L		

Table ii: Summary of socioeconomic characteristics and sensitivities

Aspect	Characteristics
Other users	
Fishing	Commercial fisheries landings and value were low within International Council for the Exploration of the Sea (ICES) rectangle 35F2. Catch composition by weight of landings from United Kingdom and foreign vessels in ICES rectangle 35F2 for 2016 was dominated by demersal species. Between 2012 and 2016, the annual total live weight of fish landed from ICES rectangle 35F2 ranged from 36 tonnes in 2012 to 151 tonnes in 2013 and total annual value from £89,658 in 2012 to £483,111 in 2013. Fishing methods include beam trawls and bottom trawls. Vessel Monitoring Systems (data for all UK vessels greater than 15 metres in length landing into UK ports for 2009 to 2013), indicate the majority of fishing effort is targeted out with the decommissioning area, although the surrounding ICES rectangles show high fishing activity for crab and lobster
Shipping activity	Shipping density within the Victoria subsea infrastructure decommissioning area is very low.
Oil and Gas	Structures within 15 km of the Victoria pipeline include the Viking BD, BC and BA platforms, and the Viking Golf, Delta, Charlie, Hotel and Lima platforms.
Telecommunications	The Tampnet cable crosses Block 49/17, 2.6 km west from Victoria subsea infrastructure.
Military activities	There are no military activity areas within 100 km of the Victoria subsea infrastructure.
Windfarms	There are four known areas of windfarm development within 50 km of the Victoria subsea infrastructure. Three of these developments are in the pre-planning stages and one site (closest at 40 km) is under construction.
Wrecks	There are four wrecks located within the Block 49/17. None are classed as designated wrecks of historical significance, however, all four are classed as dangerous.
Aggregate extraction	There are three minerals aggregate production areas located within 50 km of the Victoria subsea infrastructure.
Gas Storage	There are no known carbon capture and storage (CCS) plans in the immediate vicinity of the Victoria subsea infrastructure decommissioning area, although there are aquifers present with the potential for CCS in the southern North Sea are located within Blocks 48/19, 48/20, 49/11, 49/16 and 49/17.

0.6 Assessment of Environmental Effects & Their Significance

The potential environmental issues (or aspects) associated with the proposed Victoria decommissioning programmes were identified through discussions with the NEO project team, an informal scoping exercise with key stakeholders and from the environmental impact assessment team's previous oil and gas project experience. At the time of writing the environmental appraisal, all aspects of the proposed Victoria decommissioning programmes have 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 issues identified during the initial stage of the environmental impact assessment process were then 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.

The majority of issues 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 statement. Some issues however, were considered to be of medium risk to the environment (i.e. potentially significant). For these issues, mitigation measures were identified to either remove the potential impacts by design or minimise or manage the potential impacts through operational measures. Once mitigation measures were determined, the potential impacts were re-assessed to determine whether the overall impact significance had been reduced. These remaining impacts are referred to as the residual impacts.

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

0.6.1 Atmospheric Emissions & Energy Use

Energy use and associated emissions resulting from the proposed Victoria Field decommissioning activities are mainly attributed to the vessel and helicopter use. Standard mitigation measures have been identified to minimise energy usage by project vessels.

The atmospheric emissions from the Victoria decommissioning activities are unlikely to have any effect on sensitive receptors.

Emissions from the Victoria decommissioning activities will contribute to greenhouse gas emissions and have a non-significant cumulative and transboundary impact. Emissions will be kept to a practicable minimum. Total carbon dioxide emissions generated from the proposed Victoria facilities decommissioning operations represent a very small proportion (less than 0.3%) of the of the total annual carbon dioxide emissions from the United Kingdom continental shelf in 2016.

0.6.2 Seabed Impacts

Decommissioning operations at the Victoria Field will result in work being undertaken at or near the seabed.

The jack-up rig will be placed adjacent to the Victoria wellhead during decommissioning operations. Placement of the spudcans of the four-legged jack-up rig on the seabed will create some temporary, short-term disturbance of seabed sediments, over an estimated area of 0.00009 km^2. The spudcans will be removed from the seabed following decommissioning operations. Given the dynamic seabed conditions, recovery of the seabed and associated fauna is expected to take approximately one year.

The excavating, cutting and lifting of the Victoria subsea infrastructure will create a temporary, short-term disturbance of the seabed sediments, over an estimated area of 0.029 km^2. This disturbance will be relatively small and occur due to the seabed excavation (where required), the remotely operated vehicle (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. Recovery of the seabed and associated fauna following the removal of the subsea installations is expected to be rapid (less than a year).

Overall, the Victoria decommissioning activities are expected to create a maximum seabed impact of 0.029 km^2, representing 0.0008 % of the total area of the North Norfolk Sandbanks and Saturn Reef SAC.

0.6.3 Discharges to Sea

The flushing and flooding of the pipelines will introduce chemical contaminants to the sediment and water column, but these are expected to be quickly dispersed given the active hydrodynamics in the region and be sequestered in the sediment. Long-term degradation of the pipeline and umbilical will introduce residual chemicals to the sediment and water column over an extended period. The effect is not expected to be significant and is not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities.

0.6.4 Societal Impacts

All structural material recovered from the Victoria 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.

There will be a minor impact to fishing activities during the decommissioning operations in the Victoria area, and transient loss of access for vessels during the decommissioning operations. These impacts will be reduced by minimising the number of vessels travelling to, or standing by, the Victoria subsea infrastructure. Potential damage or loss of demersal fishing gear will be minimised through the burial of the pipeline, umbilical cut ends and the undertaking of debris and clear seabed surveys directly after decommissioning.

0.6.5 Underwater Noise

The subsea noise levels generated by surface vessels used during the decommissioning operations of the Victoria 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 Victoria Field, however, the impact from vessels is not expected to be significant.

Sound levels associated with the decommissioning of the Victoria subsea infrastructure would attenuate to ambient levels within a few kilometres of the sound source. As such, it is unlikely that sound produced by the decommissioning activities would have an effect on fish behaviour that would be noticeable at a population level. The individual and cumulative impacts from decommissioning activities at Victoria Field are not considered significant.

0.6.6 Accidental Events

Hydrocarbon releases and chemical spills are the two types of accidental events that could occur during the Victoria 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 Victoria Field would result from a loss of diesel from on-site vessels. Diesel spills will disperse and dilute quickly with spill modelling predicting that spills will not reach 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 Victoria Field will provide effective spill management in the case of an accidental event.

0.7 Environmental Management

The Victoria decommissioning will be undertaken in accordance with NEO's Management System Framework. The system follows the plan, do, learn, review model to align with HS(G)65 and is verified to OSPAR 2003/5

The integrated Environmental Management System (EMS) provides tools for managing the impacts of NEO's activities, products and services on the environment. The EMS provides a structured approach for continuous planning, implementing, reviewing and improving on environmental protection measures as well as working towards increasing environmental sustainability. NEO, through its HSE Management Framework, will ensure that any environmental risk is managed to as low as reasonably practicable.

0.8 Summary

In summary, it is concluded that the proposed Victoria Decommissioning Programmes 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 introduces NEO Energy (NEO), explains the background to the proposed Victoria Subsea Infrastructure Decommissioning project, outlines the environmental impact assessment process that has been followed for the project and defines the structure of the Environmental Appraisal (EA). It also summaries the key concerns raised during the stakeholder engagement process and, where applicable, indicates where these have been addressed within the EA.

1.1 NEO Energy

Silverstone Energy was formed in 2005 through the creation of a joint venture by Calgary-based Storm Ventures International Inc. and Lime Rock Partners. In 2010 Silverstone Energy Limited and Bridge Energy AS completed a combination agreement and became subsidiaries of the holding company Bridge Energy ASA with Silverstone being renamed Bridge Energy UK Limited. In 2013 Spike Exploration Holding AS, with HitecVision AS backing, completed an offer to acquire all outstanding shares in Bridge Energy ASA. The UK entity was separated to create Bridge Energy Holding Limited, wholly owned by HitecVision AS. In 2014 the business was renamed Verus Petroleum. In 2019 the business was renamed to NEO Energy. The Decommissioning Programmes and execution is the responsibility of NEO Energy (SNS) Limited.

1.2 Project Background & Purpose

The Victoria gas field lies in the United Kingdom Continental Shelf (UKCS) Block 49/17a in the southern North Sea (Figure 1-1), with the water depth along the pipeline varying between 21 and 27 m Lowest Astronomical Tide (LAT).

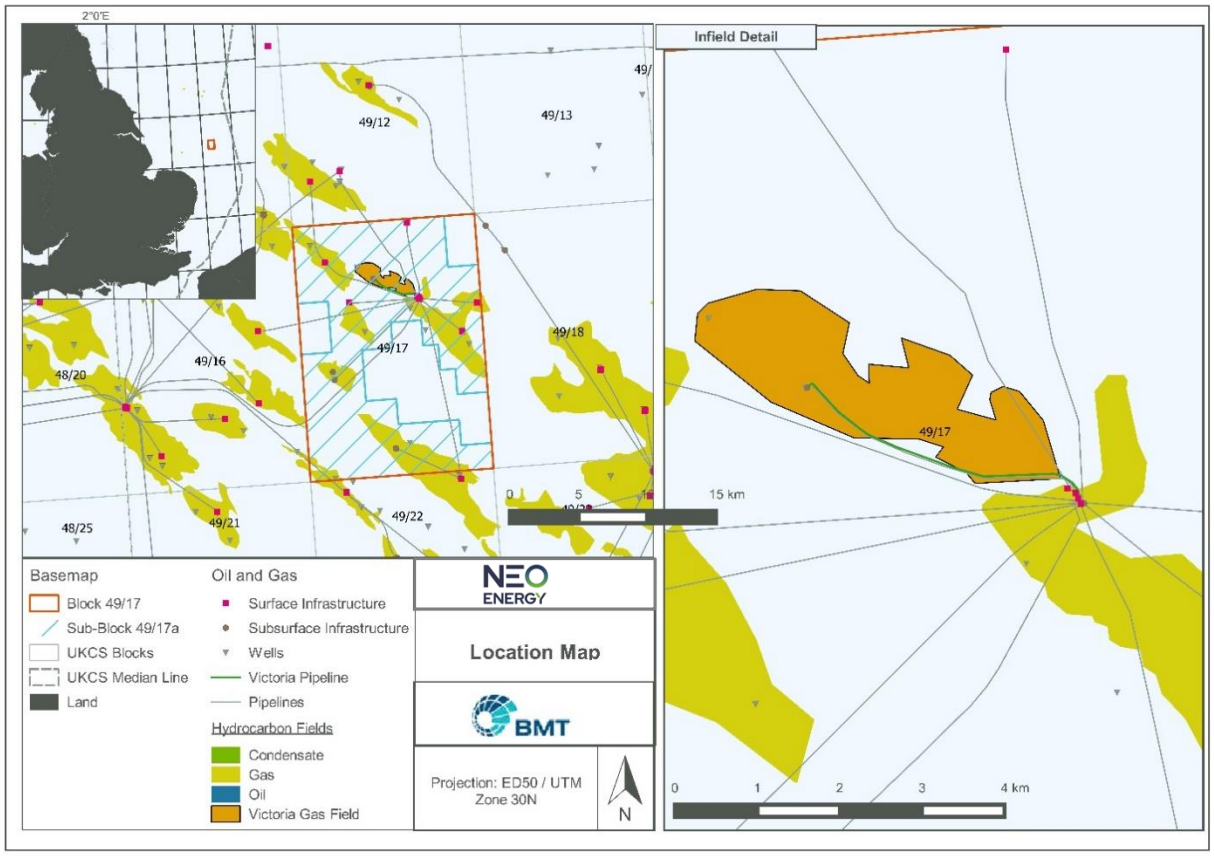


Figure 1-1. Location of Victoria Field infrastructure

The Victoria Field was discovered in January 2007 by Silverstone Energy. The exploration well, 49/17-14, was subsequently plugged and abandoned. A Field Development Plan (FDP) was submitted and approved in 2007. Appraisal well 49/17-14a was completed as a vertical and hydraulically fractured production well in August 2008. As part of the FDP, the Victoria Field was developed as a subsea tie-back to the Chrysaor owned Viking BD platform, some 3.8 km away. Production commenced in October 2008, with gas being exported to the Theddlethorpe terminal via the Chrysaor operated Viking B complex. Cessation of Production (CoP) was approved (and occurred) in January 2016.

1.3 Scope of the Proposed Decommissioning Operations

This document supports the two Decommissioning Programmes (DPs):

1. Decommissioning of the Victoria Field Installation (DP1); and
2. Decommissioning of the Victoria Pipeline and Umbilical (DP2).

1.3.1 Summary of DP1 infrastructure

The installation consists of the following subsea infrastructure:

- Horizontal tree, wellhead and protective structure;
- Victoria valve skid; and
- Concrete mattresses and grout bags.

1.3.2 Summary of DP2 infrastructure

The pipeline and umbilical consist of:

- Tree to valve skid spool;
- Tree to valve skid controls jumper (27 m);
- Valve skid to main pipeline 6 spool (two sections) (126 m);
- Umbilical at Victoria valve skid (150 m);
- Pipeline crossing over Viking AR 24”/3” lines (174 m);
- Umbilical crossing over Viking AR 24”/3” lines, (144 m);
- Pipeline to Viking BD valve skid spools (78 m);
- Umbilical at Viking BD valve skid (120 m);
- 3.95 km (approximately) 6” carbon steel production pipeline; and
- 3.95 km controls and chemical injection umbilical.

1.3.3 Proposed decommissioning approach for pipelines

Based on regulatory requirements and industry best practice, NEO proposes to remove the subsea infrastructure included in DP1, as well as part of the infrastructure included in DP2, excluding 3.69 km of the pipeline and 3.68 km of umbilical, which will be decommissioned in situ. The 174 m of production pipeline, 144 m of umbilical at the Viking AR crossing, as well as associated stabilisation materials will be left in situ. The main Victoria decommissioning activities offshore are scheduled to occur between 2021 and 2024.

1.3.4 Alternatives considered

Due to the infrastructure being a short subsea tie-back to the Viking Hub Complex (which is to be decommissioned) from which it receives power and hydraulic control, there were no realistic alternatives for the decommissioning of the subsea infrastructure.

1.4 Purpose of Environmental Impact Assessment

An Environmental Impact Assessment (EIA) is a systematic process that considers how a project will change existing environmental and societal conditions and assesses the consequence and significance of such changes (Table 1-1). EIA is an iterative process that is generally initiated at a project’s inception and provides an aid to project decision-making throughout the planning and design phases so that, where practical, potentially significant environmental effects can be mitigated at the source.

To support the Victoria DPs, the EIA process was conducted in accordance with the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended), following the Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 (OPRED, 2018). The EA presents the findings of the EIA and has been prepared as part of the planning and consents process for decommissioning of the Victoria infrastructure.

Table 1-1. Key stages of the EIA process for decommissioning

EIA Stage	Description
Scoping	Allows the study to establish the key issues, data requirements, and impacts to be addressed in the EIA and the framework or boundary of the study.
Consideration of alternatives	Demonstrates that other feasible approaches, including alternative project options, scales, processes, layouts, and operating conditions have been fully considered.
Description of project actions	Provides clarification of the purpose of the project and an understanding of its various characteristics, including stages of development, location and processes.
Description of environmental baseline	Establishes the current state of the environment on the basis of data from literature and field surveys and may involve discussions with the authorities and other stakeholders.
Identification of key impacts and prediction of significance	Seeks to identify the nature and magnitude of identified change in the environment as a result of project activities and assesses the relative significance of the predicted impacts.
Impact mitigation and monitoring	Outlines the measures that will be employed to avoid, reduce, remedy or compensate for any significant impacts. Mitigation measures will be developed into a project environmental management plan. Aspects of the project which may give rise to significant impact which cannot be mitigated to an acceptable or tolerable level of impact may need to be redesigned. This stage will feed back into project development activities.
Presentation of the Environmental Appraisal	Reporting of the EIA process through production of an EA that clearly outlines the above processes. The EA provides a means to communicate the environmental considerations and environmental management plans associated with the project to the public and stakeholders.
Monitoring	Project impacts will be monitored during the projects activities and following cessation of any operations to verify that impact predictions are consistent with the subsequent outcomes.

1.5 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 and the Energy Act 2016. 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 (BEIS) before the owners of an offshore installation or pipeline may proceed.

There is presently no statutory requirement to prepare an Environmental Statement for decommissioning. However, under the Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998 (OPRED, 2018), to inform the DP process, an EIA must be documented in an EA, which should be submitted along with the DP and any Comparative Assessment (CA).

The Guidance Notes state that an EA should include an assessment of the following:

- All potential impacts on the marine environment including: exposure of biota to contaminants specifically associated with the decommissioning of the installation/ infrastructure; 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 compartments, including emissions to the atmosphere.
- Consumption of natural resources and energy associated with reuse and recycling.
- Potential impacts on amenities, the activities of communities and on future users of the environment.

In addition, BEIS have advised the Oil and Gas Industry that under the Marine and Coastal Access Act 2009 (MCAA), an EIA/EA will be required for all license applications relating to decommissioning operations.

OSPAR Decision 98/3 (the Decision) sets out the United Kingdom's (UK's) international obligations on the decommissioning of offshore installations. The 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 tones must be completely removed for re-use, recycling or disposal on land. Any piles securing the jacket to the seabed should be cut at target depth of 3 m below the natural seabed level, however, consideration will be given to the prevailing seabed conditions and currents (OPRED, 2018). In addition to the decision, the UK is signed up to the London Convention in 1972 (as amended),

which is an agreement to ensure the prevention of marine pollution by dumping of wastes and other matters at sea alongside this the UK Government has a moratorium on dumping of waste which has been in force since 1999.

OSPAR Decision 98/3 does not include pipeline decommissioning. There are no international guidelines on the decommissioning of disused pipelines. However, the UK Petroleum Act and Pipeline Safety Regulations 1996 provide a framework for the safe decommissioning of disused pipelines. The Guidance Notes state that "Because of the widely different circumstances of each case, it is not possible to predict with any certainty what may be approved in respect of any class of pipeline". Therefore, all feasible pipeline decommissioning options should be considered and a CA undertaken. Further regulatory drivers relevant to the Victoria decommissioning project are provided in Appendix A.

1.6 Consultations

During preparation of this EA, the views of the following organisations were solicited by an informal scoping letter and report on the 12th January 2018:

- Offshore Petroleum Regulator for Environment and Decommissioning Department for Business, Energy and Industrial Strategy (BEIS/ OPRED)
- Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
- Environment Agency (EA)
- Global Marine Systems Limited (GMSL)
- Joint Nature Conservation Committee (JNCC)
- Marine Management Organisation (MMO)
- Ministry of Defence (MOD)
- National Federation of Fishermen's Organisation (NFFO)

This initial consultation was followed by statutory consultation with BEIS. Summary of this consultation is provided in Table 1-2.

Table 1-2. Statutory consultation

Consultee	Summary of issues raised	NEO'S response	EA section
BEIS	The Victoria Field is located in two Special Areas of Conservation (SACs), therefore any impact assessment must take into account the qualifying features of these SACs.	The impacts associated with seabed disturbance during operations and vessel noise have been assessed in this EIA.	5 & 8
	Environmental parameters not likely to have a significant impact can be scoped out at the front of the document.	NEO have assessed the impacts associated with decommissioning activities against environmental and societal parameters.	4
	NEO's preferred flushing option due to safety issues is flushing to sea. The estimate of condensate in the pipeline along confirmation of other contents must be provided.	NEO provides in this EA and corresponding DP full inventory for the pipeline and umbilical. Oil Pollution Prevention and Control (OPPC) permit will be applied for any discharges to sea.	6
	BEIS indicated that based on the information received to date there is insufficient information on the burial depth of the pipeline. Future survey should be based 50 m either side of the pipeline.	NEO provided Pipeline Burial Report (BMT Cordah, 2018a (NEO-OP-PLN-0002)) and further available information. A pipeline survey will be undertaken before offshore decommissioning operations commence	7
	BEIS noted that in an area of scientific interest and conservation sites, an overtrawl survey post decommissioning may not be agreed. The overtrawl works causes disturbance of the seabed over a large area and as an alternative debris and crossings could	NEO with guidance from BEIS, JNCC and NFFO will propose alternative clear seabed survey method.	2 & 5

Consultee	Summary of issues raised	NEO'S response	EA section
	be inspected via non-intrusive means. BEIS would want confirmation that safety issues are captured in another way (i.e. by visual means, recorded).		
NFFO	NFFO's concerns are with future risk to beam trawlers from pipeline and crossing left in situ. NEO should demonstrate that these areas do not pose a risk to fishing vessels. NFFO expects that these areas will be periodically surveyed.	NEO will make sure that any infrastructure left *in situ* is overtrawlable. Appropriate monitoring will be set in place as well as notices to mariners.	4
CEFAS, JNCC, MOD, MMO	No comment to Consultation Letter.		

1.7 Report Structure

The structure for this Victoria decommissioning EA is detailed in Table 1-3.

1.8 Transboundary & Cumulative Impacts

The EIA process also includes the identification of any potential cumulative and transboundary impacts that could be caused by the proposed decommissioning programme. Cumulative impacts may occur as a result of a number of activities (e.g. discharges or emissions) combining or overlapping and potentially creating a new or larger impact. Even where impacts do not overlap, it is important to consider the incremental effect of many small areas of impact on a particular environment or its use. Transboundary impacts are those which could have an impact on the environment and resources beyond the boundary of UK waters. The Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991) addresses the need to enhance international co-operation in assessing transboundary environmental impacts. The Espoo Convention was a key step in bringing together all stakeholders to prevent environmental damage before it occurs.

The EIA process assessed the transboundary and cumulative impacts of all decommissioning options within this EA document.

Table 1-3. Victoria decommissioning EA structure

Section	Description
Non-Technical Summary	A non-technical summary.
1. Introduction	An introduction to the project and the EA scope.
2. Project Description	A description of the decommissioning options and the recommended decommissioning option, as determined through a formal CA process.
3. Environmental Description	A description of the environmentally sensitive receptors in the vicinity of the project area.
4. Risk Assessment	A detailed description of the risk assessment approach and findings.
5. Seabed Impact	Identification of potential sources of impact to environmental and societal receptors, cumulative and transboundary impacts, and details of practicable mitigation strategies.
6. Discharges to Sea	
7. Societal Impact	
8. Underwater Noise	
9. Accidental Events	
10. Environmental Management	A description of NEO's environmental management procedures and how these will apply to the decommissioning of the Victoria infrastructure. This section also includes a register of commitments made within the EA.
11. Conclusions	Key findings and conclusions.
References	Sources of information used to inform the assessment.
Appendix A: Legislation	A summary of relevant environmental legislation.
Appendix B: Energy & Emissions	A summary of conversion factors and assumptions used in the energy and emissions analysis.

2 Project Description

This section presents a description of the infrastructure in the Victoria Field, the scope of the decommissioning operations, infrastructure to be decommissioned and decommissioning alternatives considered, including the selected option(s) and associated activities.

2.1 Overview

The detailed information on the infrastructure to be decommissioned is provided in the Victoria Field Decommissioning Programmes (NEO Energy). The Victoria subsea system (Figure 2-1 and 2-2) consists of:

- One subsea production well complete with protective structure;
- One production gas flowline;
- One subsea umbilical designed to provide hydraulic control, electrical signal and chemical injection cores;
- Spools for Victoria development (of similar construction as the pipeline), totalling approximately 177 m:
  - Victoria tree to Victoria valve skid, approximately 27 m;
  - Victoria valve skid to production pipeline, approximately 72 m, split into two sections; and
  - Production pipeline to Viking DB valve skid, approximately 78 m, split into three sections.
- One pipeline end valve skid (piled) at the Victoria field location to provide flowline isolations, tie-in points, and control tie-ins;
- Single subsea gas meter located on the Victoria skid;
- 153 concrete mattresses distributed between the Victoria well location, at the pipeline crossing of Viking BD to AR pipeline, and at the Viking BD skid location adjacent to the Viking BD platform;
- 13 frond mattresses surrounding the Victoria well head; and
- Unknown number of grout bags used in the construction of the crossing over Viking AR 24” and 3” lines, and to support the swan neck spools at the valve skids.

The key infrastructure locations are provided in Table 2-1.

Table 2-1: Key infrastructure coordinates

Infrastructure	Coordinates				Distance from well (m)
	Eastings	Northing	Latitude	Longitude	
Well Centre	452496.91	5924064.84	53°27' 44.115" N	2°17' 01.199" E	0
Victoria Valve Skid	452521.31	5924060.47	53°26' 50.895" N	2°20' 01.407" E	25
Mid Spool Flange (approx.)	452553.00	5924075.00	53°27' 48.733" N	2°17' 07.141" E	57
Pipeline Start of Trench	452594.31	5924076.02	53°27' 48.780" N	2°17' 09.380" E	98
Pipeline Fully Buried	452620.48	5924041.91	53°27' 47.686" N	2°17' 10.820" E	126
Umbilical Start of Trench	452603.00	5924097.50	53°27' 49.478" N	2°17' 09.841" E	11
Umbilical Fully Buried	452618.30	5924077.70	53°27' 48.841" N	2°17' 10.680" E	122
Viking BD Valve Skid	455747.78	5922382.41	53°26' 50.895" N	2°20' 01.407" E	3,660

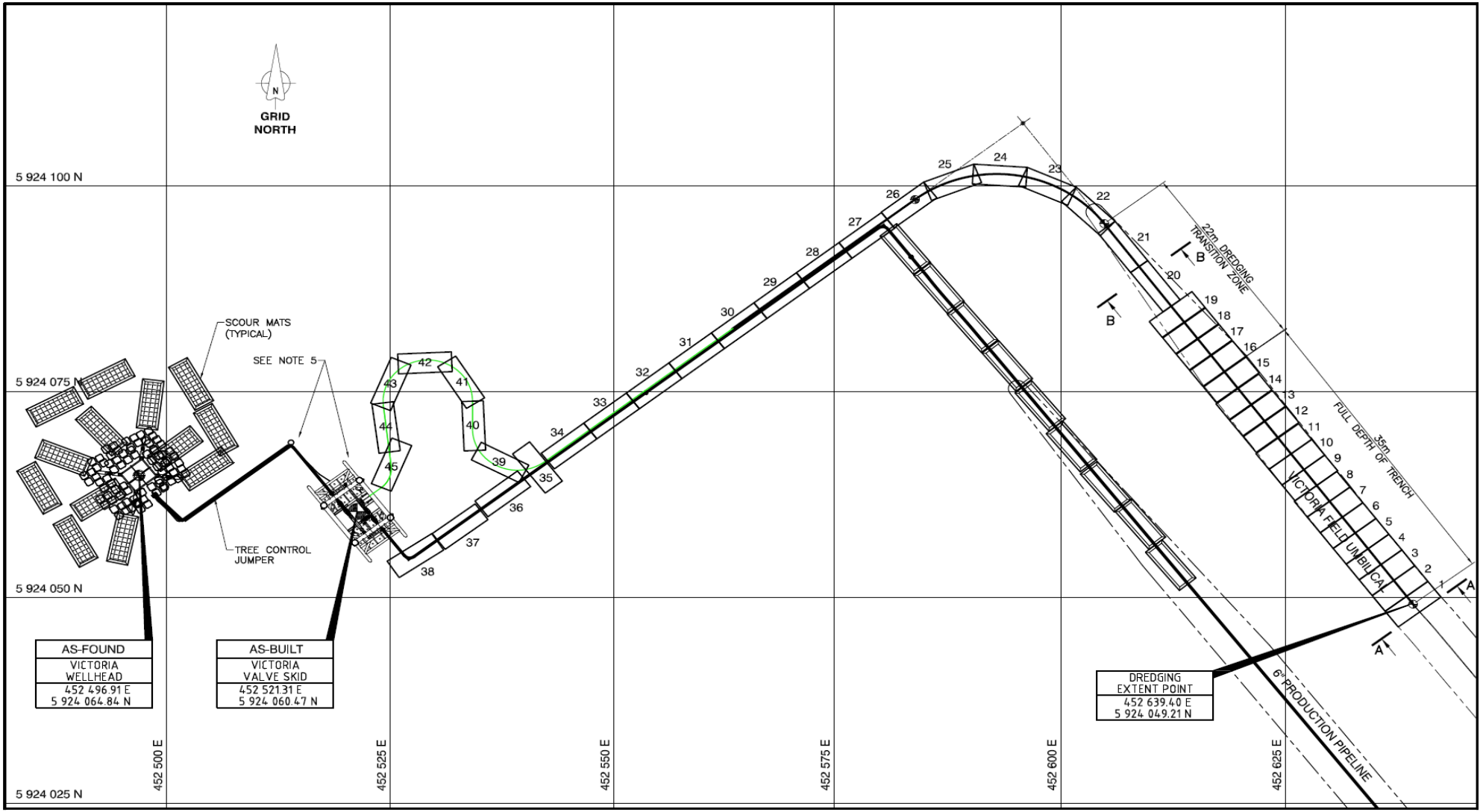


Figure 2-1: Overview of Victoria subsea infrastructure within the Victoria Field

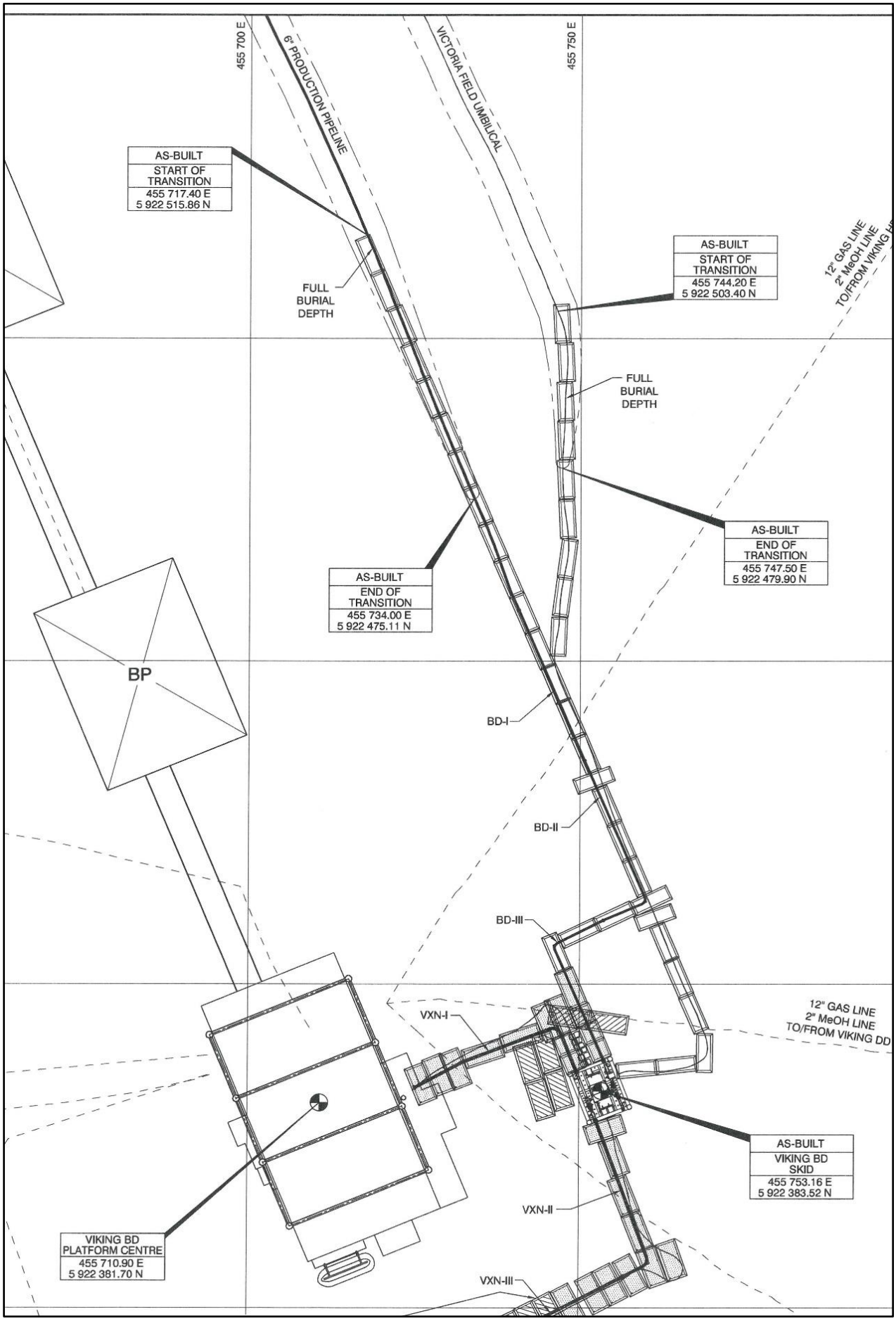


Figure 2-2: Overview of Victoria subsea infrastructure within the Viking facilities.

2.2 Well Abandonment

The Victoria tree is a 5,000 psi Vetco horizontal tree with a fishing friendly protection structure. Decommissioning of the well, tree and protection structure will be performed by others (i.e. drilling contractor), therefore, are out with the scope of this decommissioning plan. As required by NEO standards, abandonment of the well will be undertaken in accordance with Oil and Gas UK (OGUK) Guidelines for the Abandonment of Wells (OPRED, 2018). Chemical use and discharges associated with well abandonment will be assessed on well abandonment permit and marine license submissions.

2.3 Decommissioning of Victoria Field Installation

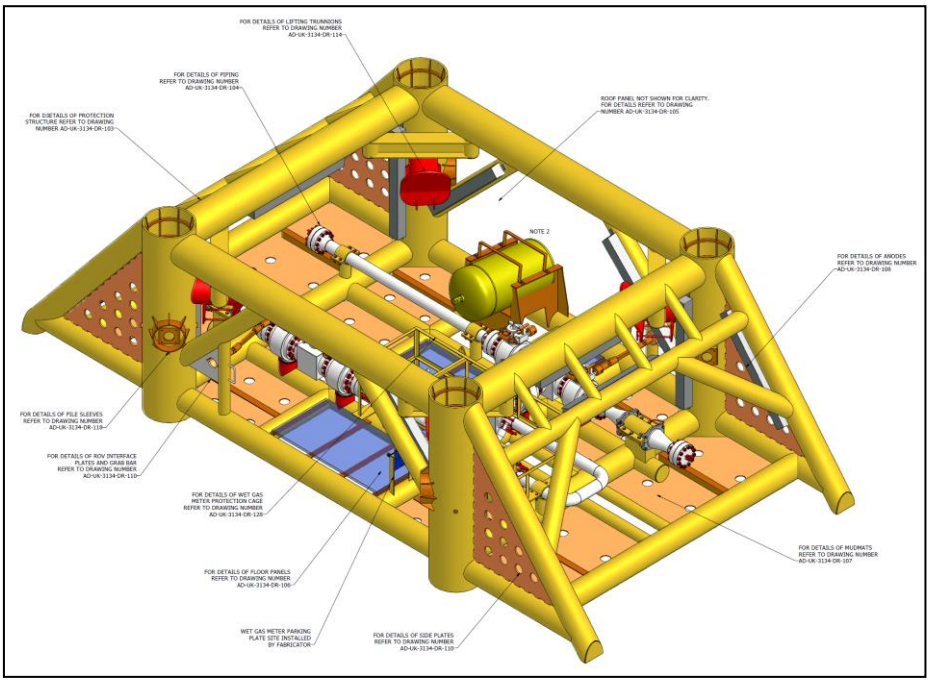
The infrastructure associated with the Victoria Field subsea installation will be removed and therefore did not necessitate a CA. Details of the infrastructure and stabilisation materials that will be removed are provided in the following subsections. The Viking BD skid will be removed through a Chrysaor decommissioning program.

2.3.1 Victoria Valve Skid Structure

The Victoria valve skid (Figure 2-3), provides the termination point for the Victoria pipeline and umbilical. The structure weighs approximately 48 tonnes in air, including the weight of the removable roof panel (Verus Petroleum, 2017a). The structure is piled in each of the four corners and secured by pile pins. The piles are 610 mm diameter and 25.4 mm wall thickness (approximately 370 kg/m). Decommissioning of the skid will require removal of 24 m of piles in total (four piles - three metres above seabed and three metres below seabed).

2.3.2 Concrete Mattresses & Grout Bags

In total there are 66 plain concrete and 13 fronded anti-scour mattresses at the Victoria well. At the Viking BD skid and the crossing of the Viking pipeline there are 87 plain concrete mattresses (Verus Petroleum, 2017a). The mattresses are 6 m x 2.4 m x 0.15 m in size, weighing four tonnes each in air. The mattresses are of concrete and polypropylene construction and, except at the crossing, will be removed where safe to do so. Grout bags were used in the construction of crossings and to support the swan neck spools at the valve skids. The number of grout bags used is unknown. Similarly, the intention is to remove these grout bags where safe to do so.



Source: NEO Energy

Figure 2-3: Victoria Valve Skid (roof panel not shown)

2.4 Decommissioning of Pipeline & Umbilical

In order to inform a decision on the best option for decommissioning of the pipeline and umbilical a CA was undertaken. The CA included an assessment of removal and flushing options. A description of the Victoria pipeline and umbilical, as well as associated infrastructure to be decommissioned is provided in the following subsections.

2.4.1 Victoria Field Pipeline

The production pipeline extends from the Victoria valve skid to the Viking BD valve skid (with connecting spools at each end). The key data for the Victoria production pipeline are as follows:

- Approximately 3.8 km long;
- 6” nominal bore, 12.7 mm wall thickness, X65 carbon steel;
- 2.5 mm 3LPP (linear polypropylene) anti-corrosion coating;
- Approximately 50 kg/m dry, empty weight (including coating, not including anodes);
- Internal volume of approximately 60 m^3.

The majority of the pipeline has been trenched and buried (BMT Cordah, 2018a, NEO-VC-OP-PLN-0004). The pipeline crosses the Viking AR 24” and 3” lines within the Chrysaor Viking 500 m safety zone, near to the BD skid. The lengths of spools for the Victoria development are approximately 177 m. They are split as follows:

- Victoria tree to Victoria valve skid (27 m);
- Victoria valve skid to production pipeline, split into two sections (72 m); and
- Production pipeline to Viking BD skid, split into three sections (78 m).

The first spool section downstream from the pipeline at the Viking BD end crosses the Viking HD 12”/ 2” pipelines. The spools are of similar construction to the pipeline and therefore also weigh approximately 50 kg/m in air. Flanges are approximately 80 kg/m in air per half (based on 6” API 17B flange).

The last recorded pipeline pressure following re-pressurisation and disconnection was approximately 5 barg. Considering a pipeline volume of 60 m^3, the volume of expanded gas from the pipeline in the atmospheric pressure would be 375 sm^3 (13,200 scf), at a subsea temperature of 4°C (Verus Energy, 2018b).

The as-left condensate contents are estimated to be between 0 and 0.6 m^3, considering the pipeline was not in practice blown down quite to atmospheric pressure, and assuming the liquid hold-up in the pipeline could have been as high as 30% prior to blowdown. When the pipeline pressure is reduced to atmospheric pressure the hydrocarbon liquid fraction is nil, which means all the condensate vaporises into the gas phase during the blowdown. However, the steady state assessment assumes no condensate hold-up in the pipeline. In reality, there would be condensate build-up in the pipeline due to elevation differences between the subsea well and the top of the riser at the platform (Verus Energy, 2018b).

2.4.2 Victoria Field Control Umbilical

A 3.9 km controls and chemical injection umbilical was laid between the Victoria and Viking valve skids in a separate trench to the production pipeline. The umbilical cross section is shown in Figure 2-4.

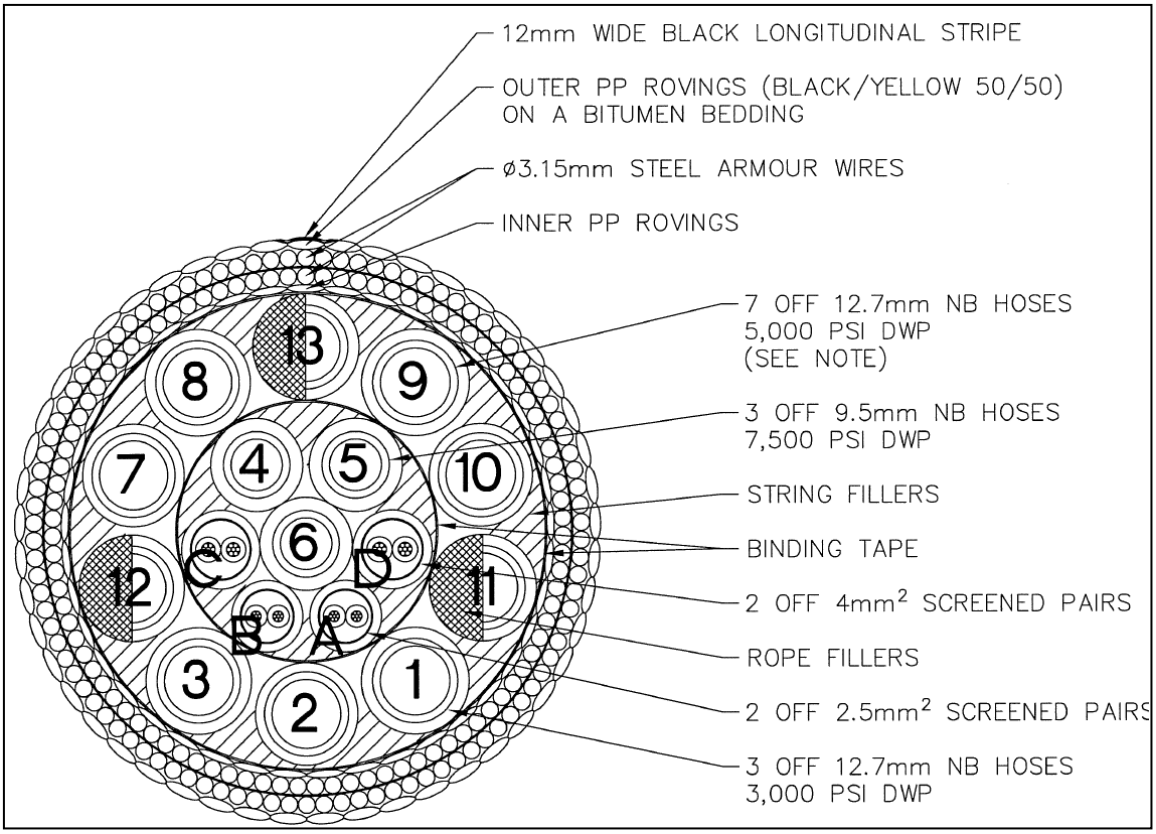


Figure 2-4: Control and chemical injection umbilical cross section

The control umbilical weighs 17.6 kg/m. The volumes of the cores, for flushing purposes, are summarised in Table 2-2. The biodegradable water-glycol subsea hydraulic control fluids, Aqualink 300E and 300F represent 1,562 litres and 781 litres, respectively, of the total fluids within the umbilical (Verus Petroleum, 2018b). There are 1,002 litres of methanol (CH_3OH) with 0.005% (0.5 litres) of corrosion inhibitor (K15351). The remaining fluid is deionised water (1,002 litres). The methanol and Aqualink are considered, under the OSPAR list of substances and preparations used and discharged offshore, to pose little or no risk to the environment (PLONOR).

Table 2-2: Contents and volume of umbilical cores

Core number	Function	Diameter (mm)	Volume (litres)	Comments
1	LP A	12.7	501	Used during field life – filled with Aqualink 300E
2	LB B	12.7	501	Used during field life – filled with Aqualink 300E
3	LP Spare	12.7	501	Spare not used during field life – filled with Aqualink 300F
4	HP A	9.5	280	Used during field life – filled with Aqualink 300E
5	HB B	9.5	280	Used during field life – filled with Aqualink 300E
6	HP Spare	9.5	280	Spare not used during field life – filled with Aqualink 300F
7	Methanol 4	12.7	501	Not used during field life. Blanked at Victoria skid on UTA. Contains shipping fluid, deionised water and dye
8	Methanol 5	12.7	501	Not used during field life. Blanked at Victoria skid on UTA. Contains shipping fluid, deionised water and dye
9	Methanol 6	12.7	501 MeOH 0.25 CI	Used during field life – Methanol/ corrosion inhibitor mixture. Corrosion inhibitor is KI5351 at 0.005% dosage
10	Methanol 7	12.7	501 MeOH 0.25 CI	Used during field life – Methanol / corrosion inhibitor mixture. Corrosion inhibitor is KI5351 at 0.005% dosage
11	Methanol 1	n/a	n/a	This hose was not required by Victoria -replaced with rope filter
12	Methanol 2	n/a	n/a	This hose was not required by Victoria -replaced with rope filter
13	Methanol 3	n/a	n/a	This hose was not required by Victoria -replaced with rope filter

Source: Verus Petroleum (2018b)

2.5 Decommissioning options

This section outlines the available and chosen options for the decommissioning of the Victoria subsea infrastructure. It also provides an overview of the CA process (BMT Cordah, 2018b, NEO-VC-OP-PLN-0003) used to identify the best option for pipeline decommissioning and pipeline flushing.

2.5.1 Comparative Assessment

Five options for the decommissioning of the Victoria pipeline and umbilical and six flushing options for flooding and degassing the pipeline were considered within the CA *(NEO-VC-OP-PLN-00003)*. The individual decommissioning options were assessed against five main criteria: Technical Feasibility; Safety; Environmental; Societal; and Economic (BMT Cordah, 2018b).

In preparation for the CA, NEO identified and described the decommissioning options, decided upon and the assessment criteria (and sub-criteria) to be used, and established the weighting to be applied to scores for the individual criteria. A workshop was conducted in November 2017 to assess the technical feasibility, environmental and societal risks.

All options, which scored between minor and moderate for technical feasibility, were taken forward for further assessment against the remaining criteria. The remaining criteria were assessed against a mix of qualitative and quantitative methods. To enable a comparison to be made of the decommissioning options, the results were collated and compared using a normalised/ weighted scoring system. The results of each of the assessments were expressed in common units and ranked in order of performance from best to worst. The five pipeline and umbilical decommissioning options selected for assessment through the CA process were:

- Option P1 – full removal of all seabed infrastructure (cut and lift of pipeline, reel umbilical back on vessel);
- Option P2a – partial removal of the seabed infrastructure (cut and lift pipeline ends, crossing and reel back umbilical);
- Option P2b – partial removal of the seabed infrastructure (cut and lift pipeline ends and reel back umbilical);
- Option P3a – leave in situ (only pipeline ends removed); and
- Option P3b – leave in situ (pipeline ends and Viking AR crossing removed).

The six flushing options for the Victoria pipeline evaluated through the CA process were:

- Option F1 – using a dive support vessel (DSV) flush from the Viking BD skid through to the tree and directly re-inject fluids (gas and condensate) downhole into the well, when the rig is on location;
- Option F2 – using a DSV flush from the Viking BD skid through the tree and onto the rig via the workover riser. Gas will be vented on the rig and fluids collected for disposal onshore;
- Option F3 – using a DSV flush from the Viking BD skid through to the Victoria valve skid and onto the rig via a separate flowline spool from the rig. Gas will be vented on the rig and fluids collected for disposal onshore;
- Option F4 – using a DSV flush from the Viking BD skid through to the Victoria valve skid and then into a separate collection vessel/ platform support vessel (PSV). Gas will be vented on the PSV and fluids collected for disposal onshore;
- Option F5 – using a single vessel to vent the pipeline to sea at the Victoria valve manifold and allowing free flood from Victoria. Vessel will be relocated to the Viking BD skid and remaining contents flushed to sea;
- Option F6 – using one vessel to open valves to allow free flooding of the pipeline, no flushing.

The CA concluded that Option P3a, leave pipeline and umbilical in situ with removal of pipeline ends, is the preferred option for decommissioning of Victoria pipeline and umbilical due to high (best) scores against the majority of criteria. This option has markedly lower requirements for subsea intervention, lower risk to the decommissioning workforce offshore and associated transport on land (Safety), lowest impact to environmental receptors (Environmental Risk), lowest energy and atmospheric emissions due to lower vessel time and onshore requirements (Energy use and Atmospheric Emissions), and was least expensive option (Economic).

NEO intends to remove mattresses and grout bags, wherever safe to do so, with the exception of 44 mattresses and unknown number of grout bags associated with pipeline crossing left in situ.

The pipeline crossing between Chrysaor AR and Victoria pipelines, and associated protective mattresses and grout bags, will remain in situ. Both pipelines are out of use, with crossing currently protected by mattresses, with much of it covered by sand. Chrysaor has been granted an approval to leave AR pipeline in situ, therefore, NEO proposes to align their option with this approach and leave crossing in situ. Chrysaor will have to issue letter of approval for this approach.

Of the technically feasible pipeline flushing options, Option F5, is the preferred option. This option uses a vessel to vent the pipeline to sea at the Victoria valve manifold, allowing free flood from Victoria. This is then followed by relocation of the vessel to Viking BD skid and flushing the remaining contents to sea. Though it is the second-best scoring option, it was selected over Option F6, due to safety concerns to divers during decommissioning activities from gas that could be trapped in the pipeline.

2.5.2 Decommissioning Methodology

The objective for the abandonment of the subsea infrastructure is to minimise the damage to the environment whilst removing items which under current guidelines and regulations are to be removed and where appropriate recycled. The subsea infrastructure, valve skid, mattresses and wellhead protection structure (WHPS), will be removed. The majority of the pipeline and umbilical will be decommissioned in situ, with only the ends of the pipeline and umbilical, which are buried less than 0.6 m) being removed in accordance with the Decommissioning of Offshore Oil and Gas Installations and Pipelines Under the Petroleum Act 1998.

For the removal of all of the subsea infrastructure (other than the pipeline and umbilical total lengths) an approximate deck space required for the subsea infrastructure and decommissioning tools is shown in Table 2-3. A typical sized DSV, with approximately 1000 m^2 of deck space, should be able to recover all the subsea infrastructure in one trip. This will be confirmed with the preferred contractor.

Table 2-3: Estimated deck space required for transport of decommissioned subsea infrastructure

Item	Footprint	Required deck space (m^2)
Victoria Valve Skid	1 x 12 m x 6 m	72
25 stacks of 5 mattresses	25 x 6 m x 3 m	450
3 (assumed) recovery baskets	3 x 12 m x 3 m	108
Powered reeler	1 x 3 m x 3 m	9
Shears, grapple package, HPU etc.	-	60
ROV	-	20
TOTAL		**719**

Source: Verus Energy (2017a)

There are a number of options for the removal of the pipeline spools and short pipeline sections from the seabed including:

- Diver disconnect at each flanged end followed by spool recovery using lift beam;
- Cut spools into discrete lengths and recover each section individually to vessel using subsea grab or similar; and
- Cut spools into discrete lengths and recover multiple sections using subsea basket to vessel.

Cutting tools on the market include diamond wire, water jet cutting and subsea shears. For the purposes of vessel time estimates subsea shears have been assumed for cutting of the spools and pipeline lengths. Subsea shears have also been assumed for cutting of the skid piles and for cutting the ends of the umbilical.

2.5.3 Post-decommissioning Surveys

Several surveys will be carried out following decommissioning activities to make sure the seabed is clear of debris, and to assess the environmental impacts of decommissioning (if any).

2.5.3.1 Debris Clearance & Clear Seabed Survey

A post-decommissioning clear seabed site survey will be carried out within a 100 m corridor centred on the route of the pipeline and umbilical, as well as 500 m radius around pipeline crossing decommissioned *in situ*. Any significant seabed debris will be recovered and transported to shore for disposal or recycling in line with existing disposal methods.

As agreed with BEIS during pre-submission consultations, due to the sensitive environmental setting (Section 3) an alternative, non-invasive, method of survey and debris clearance along the pipeline corridor and areas where decommissioning work has not directly taken place will be used. This will be followed by a statement of clearance to all relevant governmental departments and non-governmental organisations (NGO).

2.5.3.2 Environmental Seabed Survey

A post-decommissioning environmental seabed survey, along the pipeline and umbilical route, will also be carried out. The survey will focus on the relevant potentially significant impacts of decommissioning and will be compared to the findings of the previously carried out environmental baseline site survey (ConocoPhillips, 2015). This will also set the baseline for any ongoing monitoring of the site post-decommissioning.

2.5.3.3 Ongoing Monitoring & Evaluation

With any materials decommissioned *in situ*, the Operator has a liability to monitor and mitigate any impacts from these materials. As the pipeline, umbilical and pipeline crossing are to be decommissioned *in situ*, they will be the subject to on-going surveys when the Victoria decommissioning activities are concluded. After the initial post-decommissioning site survey reports have been sent to BEIS and reviewed, a post-decommissioning monitoring survey regime will be agreed by both parties.

2.6 Disposal of Decommissioning Materials

In line with waste hierarchy principles, reuse of subsea installations (or parts thereof) was first in the order of preferred decommissioning options for assessment. The reuse of the wellhead, wellhead protection structure and valve skid is not considered likely, but the option will be considered.

Recovered infrastructure will be returned to shore and transferred to a suitably licensed decommissioning facility. It is expected that the structures, spool pieces and umbilical would be cleaned before being recycled. Concrete mattresses, frond mats and grout bags will be cleaned of marine growth onshore if required.

NEO will continue to engage with other companies and wider industries to discuss reuse opportunities. NEO believes that further reuse or resale opportunities will be best achieved through the tendering and selection of a waste management contractor with the required knowledge and experience in this area. Final disposal routes and historical performance will be a key consideration within the tendering process to ensure the aims of the waste hierarchy are best achieved. This will form part of NEO's Supply Chain Assessment Process and discussions with the Oil and Gas Authority (OGA).

It is expected that the steel from the subsea installations (wellhead, WHPS and valve skid) will be recycled as will be the pipeline ends and spools. This would account for approximately 95% of the steel brought to shore. Recycling of the umbilical will be difficult and it is likely to go to landfill. However, NEO will continue to engage with other companies and wider industries to discuss reuse/ recycling opportunities. Final disposition of the concrete mattresses is unknown at this time, since NEO is in discussion with waste contractors for reuse of the mattresses and/ or concrete. If no reuse can be identified, the mattresses will go to landfill.

Table 2-4 lists the expected tonnage and planned disposal routes of the decommissioned materials.

Table 2-4: Inventory tonnage and disposal routes

Decommissioned item	Total inventory (tonnes)	Disposal on shore (tonnes)	Disposal in situ (tonnes)
Subsea installations	102	102	0
Pipeline	201	11	190
Umbilical	63	5	58
Concrete mattresses	612	436	176
Frond mattresses	52	52	0

2.7 Atmospheric Emissions & Energy Use

This subsection provides quantitative estimates of the energy use and the atmospheric emissions from the proposed Victoria decommissioning activities.

This energy and emissions assessment was based on the Institute of Petroleum (IoP) "Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures" (IoP, 2000), and included:

- 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 used the energy use and atmospheric emission factors provided within IoP (2000) guidelines (Appendix B). 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 following sources were considered to have an associated impact on the energy and emissions at each stage of the Victoria 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.

A summary of the anticipated energy use and atmospheric emissions for the Victoria decommissioning activities are provided in Table 2-5 and Table 2-6, respectively.

The total annual CO_2 emissions from offshore oil and gas UKCS operations during 2016 were 13.1 million tonnes. The estimated CO_2 emissions released during the decommissioning of the Victoria infrastructure and flushing operations represent less than 0.03% of this total (Oil and Gas UK, 2017).

Table 2-5: Total energy use for the Victoria decommissioning

Decommissioning aspect	Energy use (GJ)	Approximate contribution (%)
Subsea infrastructure decommissioning operations		
Vessel and helicopter use	39,721	71.3
Onshore transportation	236	0.4
Recycling	541	1.0
New manufacture to replace recyclable materials left in situ or landfilled	9,019	16.2
Flushing operations		
Vessel and helicopter use	6,155	11.1
TOTAL	55,673	100.0

Table 2-6: Total atmospheric emissions for the Victoria decommissioning

Decommissioning aspect	Emissions (tonnes)				Approximate CO_2 contribution (%)
	CO_2	NO_X	SO_2	CH_4	
Subsea infrastructure decommissioning operations					
Vessel and helicopter use	2,948	54	4	0	74.2
Onshore transportation	17	0	0	ND	0.4
Recycling	57	0	0	ND	1.4
New manufacture to replace recyclable materials left in situ or landfilled	492	1	2	0	12.5
Flushing operations					
Vessel and helicopter use	457	9	1	0	11.5
TOTAL	3,971	65	7	0	100.0

* ND indicates that no data is available to enable a conversion to be made between a particular operation and the resulting gaseous emissions

2.8 Decommissioning Schedule

On approval of the Decommissioning Programmes, NEO will investigate the use of contracts for the main work scopes. For all work scopes NEO will schedule the work to provide a large window of operations to allow contractor flexibility with the intent of minimising costs.

For the subsea flushing and inspection work scope and the removal scope two separate mobilisations are anticipated. For both scopes, NEO will prequalify a select number of contractors with experience of similar scopes, availability of vessels in this area and the potential for campaign operations. NEO intends to undertake the well plug and abandonment (P&A) works as part of a multi-well campaign either through a well management contractor or direct with a rig operator.

Disposal of the recovered items from the field will be transported to a designated shore base and received by a recognised and approved waste management contractor for onward reuse, recycling or disposal. This waste management contractor will be selected following a tender process and an environmental and safety audit by NEO.

Decommissioning offshore activities are expected to start in 2021 and extend through 2024. Figure 2-5 presents the anticipated decommissioning schedule.

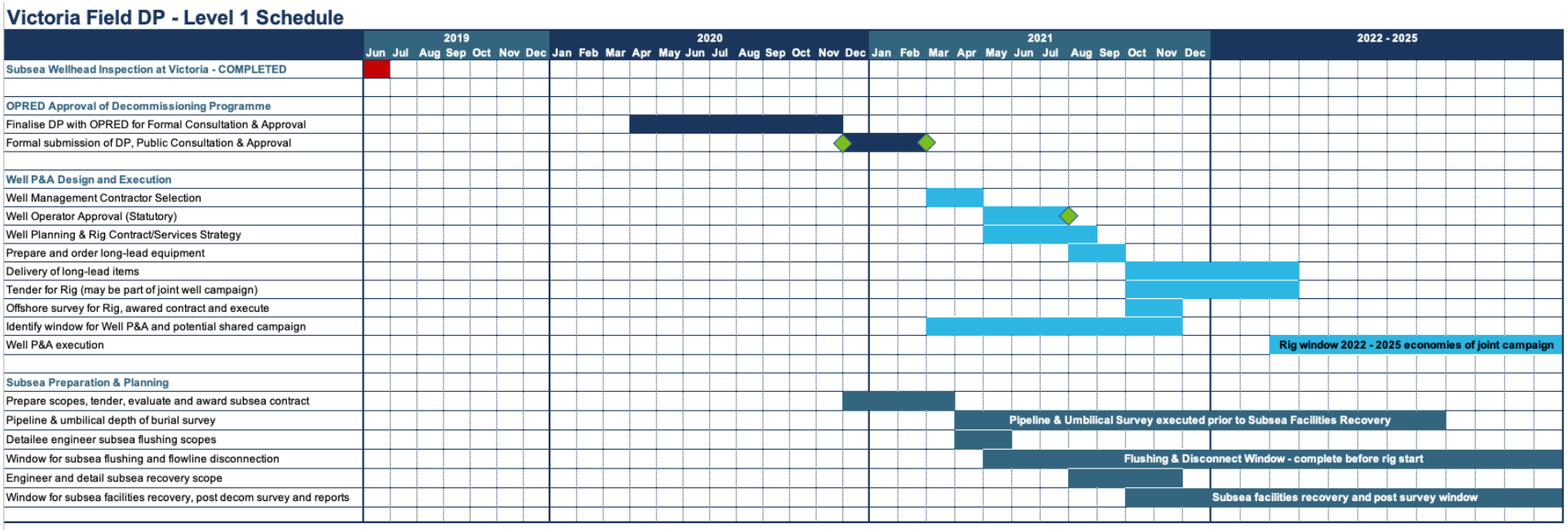


Figure 2-5: Anticipated decommissioning schedule

3 Environmental Baseline

This section describes the baseline environmental setting and main socioeconomic characteristics of the proposed area within which decommissioning activities will take place and identifies those components of the physical, chemical, biological and socioeconomic environments that might be sensitive to the potential impacts arising as a result of the proposed activities. An understanding of the environmental and socioeconomic sensitivities at the local and regional level informs the assessment of the environmental impacts and risks associated with the decommissioning activities.

The infrastructure associated with the Victoria gas field are located within UKCS Block 49/17a of the UKCS SNS, 87 km northeast of the North Norfolk coastline and 45 km west of the UK/ Netherlands median line (Figure 1-1).

3.1 Physical Environment

Characteristics of the bathymetry, currents, meteorology, sea temperature, salinity and seabed sediments in the area around the Victoria Subsea Infrastructure are described in the following subsections.

3.1.1 Bathymetry

The bathymetric variation within the wider area around the Victoria infrastructure is considered to be directly related to the presence and location of seabed features, such as sandbanks, sandwaves and sandbars (Figure 3-1). Along the Victoria pipeline route, the seabed varies between 21 and 27 m Lowest Astronomical Tide (LAT) (Figure 3-2). The shallowest areas along the pipeline route correlate with a number of sand waves, the crests of which are orientated northeast-southwest, and cross perpendicular to the pipeline route (Figure 3-2). Localised scour (up to 1.5 m below the surrounding seabed) has been observed to the northeast and southwest of the wellhead protection structure (Bridge Energy, 2013). These features are evidence of the highly dynamic nature of the seabed across the area.

3.1.2 Waves

Significant wave heights in the vicinity of the Victoria infrastructure exceed 2.5 m for only 10% of the year. However, there is evidence of considerable seasonal variation between sea states, with waves in excess of 4 m recorded for 15% of the time in autumn and winter, but only 2% of the time in summer. Wave direction is variable throughout the year, but in the later part of the year these are predominantly from the southwest (OESEA, 2016).

3.1.3 Water Circulation & Tides

The Victoria infrastructure is located in an area influenced by southern North Sea current and Channel currents. The cyclonic, counter current created from the ingress of water through the channel drives the near surface current towards a more easterly direction. The shallower waters of the SNS remain permanently mixed throughout the year due to the influence of tidal currents (OSPAR, 2000; OESEA, 2016). This prevents the formation of a thermocline and results in a highly dynamic marine environment (OESEA, 2016).

Tidal current velocities over the Victoria are between 0.25 and 0.5 m/s (neap tides) and 0.5 to 1.0 m/s (spring tides) (ABPmer, 2016).

Currents in the vicinity of sandbanks, such as those around the Victoria infrastructure, can be highly affected by their presence. Residual currents near the seabed have been shown to be strongest towards the crest of a sandbank and in opposing directions on either side of the bank running in a clockwise direction, i.e., from southwest on the southern side and from the northwest on the north residual circulation around the bank. Episodic currents, induced by wave action and storm surges, also influence sandbank development (OESEA, 2016).

3.1.4 Wind

Regional assessments indicate that the annual wind speeds in the vicinity of the Victoria subsea infrastructure are within the range 9.0 to 10 m/s, with seasonal variability ranging such that winter wind speeds can reach 12.0 m/s (ABPmer, 2016). Although there is some seasonal variation in wind direction, the predominant wind direction is south-westerly. From April to July the prevailing wind directions are north-northeast (ConocoPhillips, 2003).

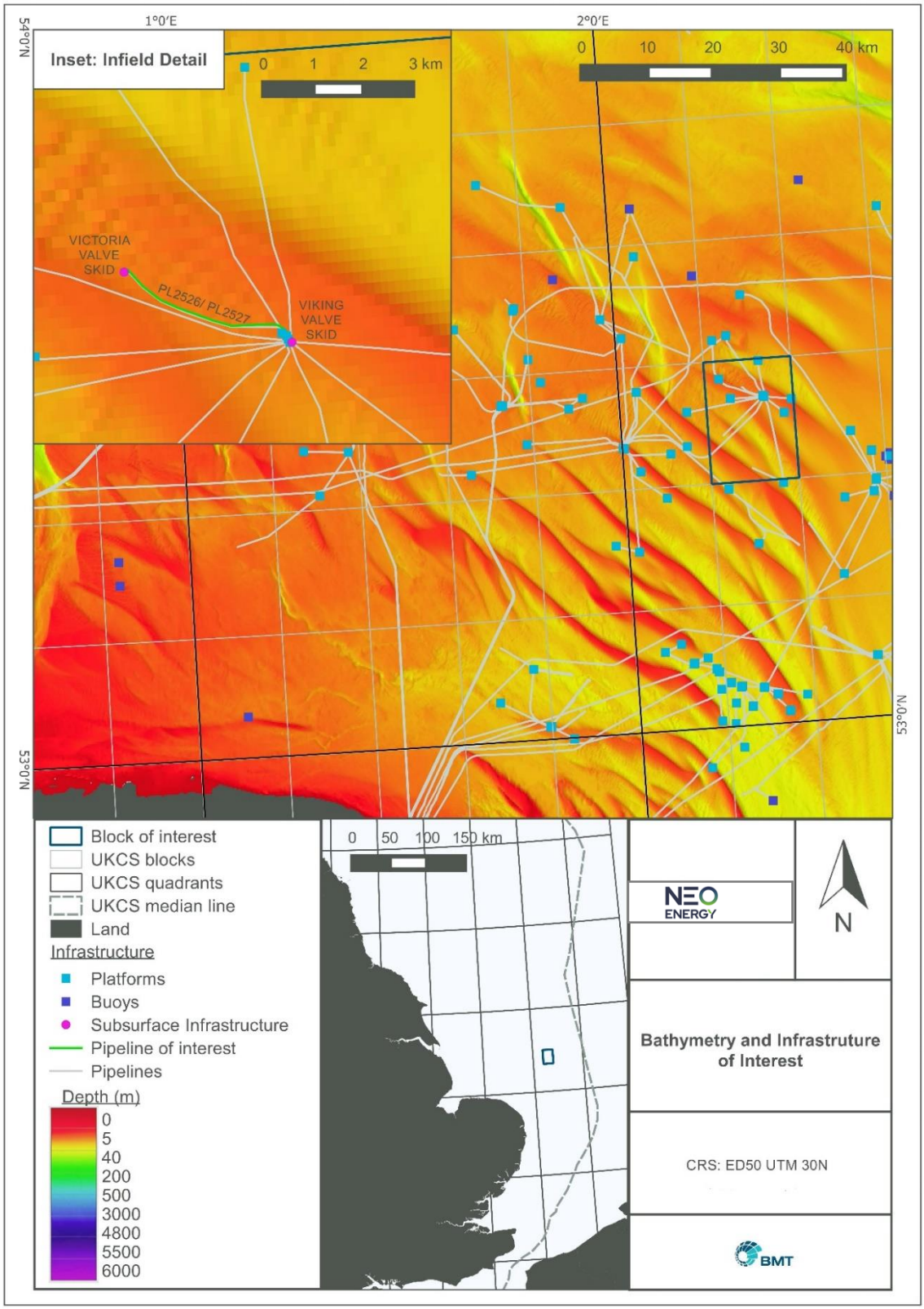
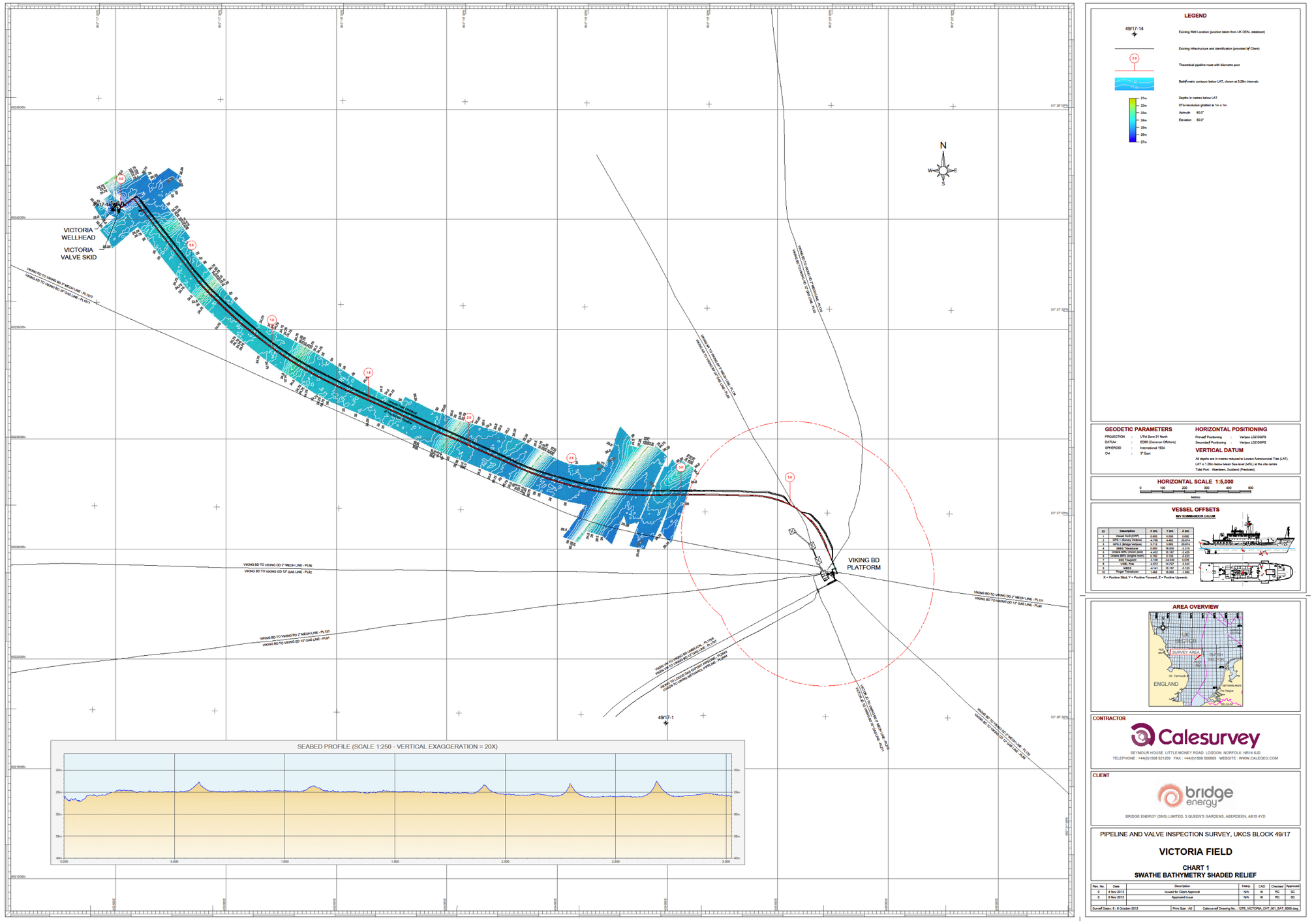


Figure 3-1: Bathymetry of the area surrounding the Victoria subsea infrastructure



Source: Bridge Energy (2013)

Figure 3-2: Swathe bathymetry shaded relief

3.1.5 Air Quality

An understanding of the existing air quality in the area of a development is useful when assessing the potential future impact upon air quality from the proposed operations. However, data on air quality offshore is limited. Emissions of CO_2, oxides of nitrogen (NOx) and oxides of sulphur (SOx) will result from power generation for vessels during operations. Further information on air quality and energy and emissions is provided in Section 2.7.

3.1.6 Sea Temperature and Salinity

Sea temperature and salinity affects both the properties of the seawater and the fate of spills or discharges into the environment. Generally, areas south of 54ºN remain vertically mixed all year round with little evidence of thermal stratification often seen in deeper water to the north. This is a result of the shallower water in the southern North Sea being susceptible to tidal stirring which is sufficient to overcome the inputs of thermal energy (OESEA, 2016). Due to the mixing at these shallow depths, there is little variation in salinity with depth.

Mean sea surface temperatures across the area surrounding the Victoria infrastructure are between 15 and 16°C in summer and 5°C in winter. Mean bottom water temperatures are, approximately, 15.5°C in summer and 5°C in winter. The salinity of the water column is around 34.5 ppt throughout the year (UKDMAP, 1998).

3.1.7 Seabed Sediments

The sediments in Block 49/17a are classified as very poorly to moderately well sorted, fine sand to fine gravel with low content of silt/ clay and organic matter (ConocoPhillips, 2015).

3.1.7.1 Sediment chemistry

Gas chromatographic profiles of the surface sediments in Block 49/17 are generally similar across the area indicating that the hydrocarbons present are derived from a combination of weathered petroleum residues and a range of biogenic hydrocarbons typical of background southern North Sea sediments. The total hydrocarbon concentrations (THC) values are lower than the average background concentrations and comparison of the metals concentrations with the cited data (e.g., UKOOA, OSPAR) indicates that the survey data are within the range of natural background concentrations for the region and well below the ERL (Effects Range Low) (ConocoPhillips, 2015).

3.1.7.2 Suspended sediments

The level of suspended sediments within the water column is directly related to the availability of material to be suspended, and the ability of the metocean (wave and tide) regime to mobilise and transport the sediment. When combined with the energetic wave and tide conditions (Section 3.1.2 and 3.1.3), the sandy sediments in the Victoria area are susceptible to suspension and mobilisation. Storm surges will further enhance sediment transport, resulting in considerable increases in suspended sediments (ABPmer, 2011).

3.2 Biological Environment

This section summarises the characteristics of plankton, benthos, finfish and shellfish spawning and nursery grounds, marine mammals, seabirds and offshore conservation areas relevant to the Victoria decommissioning area.

3.2.1 Plankton

Plankton are defined as small plants (phytoplankton) and animals (zooplankton), which live freely in the water column and move passively with the water currents (Lawrence, 2000). Plankton forms a fundamental link in the food chain and vary seasonally in community structure according to temperature, water column mixing and nutrient availability.

The SNS is characterised by shallow, well-mixed waters, which undergo large seasonal temperature variations (JNCC, 2004). The region is dynamic with considerable tidal mixing and nutrient-rich run-off from the land (eutrophication). Under these conditions, there is consistent nutrient availability throughout the year and organisms, such as diatoms, are particularly successful (Margalef, 1973, after Leterme et al., 2006). However, the phytoplankton community in the SNS is dominated by the dinoflagellate genus *Ceratium* (*C. fusus, C. furca, C. lineatum*), along with higher numbers of the diatom, *Chaetoceros* (subgenera *Hyalochaete* and *Phaeoceros*) than are typically found in the northern North Sea (DECC, 2001).

The zooplankton community is dominated by copepods including *Calanus helgolandicus, C. finmarchicus, Paracalanus* and *Pseudocalanus spp., Acartia spp., Temora spp*. and cladocerans such as *Evadne* spp.

(OESEA, 2016). However, there has been a marked decrease in copepod abundance in the SNS, which has been linked to changes in global weather phenomena (OESEA, 2016). The planktonic assemblage in the vicinity of the Victoria subsea infrastructure is not considered unique.

3.2.2 Benthic Fauna

The European Nature Information System (EUNIS) indicates the main Victoria area habitat type as A5.27 deep circalittoral sand. These habitat types are typically made up of clean fine sands or non-cohesive circalittoral muddy sands with silt content, respectively.

Additionally, in Block 49/17a the following habitats were recorded:

- A5.25 or A5.26 - Circalittoral fine sand or circalittoral muddy sand;
- A5.23 or A5.24: Infralittoral fine sand or infralittoral muddy sand;
- A5.13: Infralittoral coarse sediment; and
- A5.14: Circalittoral coarse sediment.

These habitats are generally found in water depths of over 15 to 20 m and characterised by a wide range of echinoderms (in some areas including the sea urchin (*Echinocyamus pusillus*)), polychaetes and bivalves. These circalittoral habitats tend to be more stable than their infralittoral counterparts and as such support a richer infaunal community (EUNIS, 2017).

Numbers of taxa, individuals and diversity across Block 49/17 are low to moderate (CononcoPhillips, 2015). Dominant taxa across the area are thought to be typical of the mobile sand and coarser sediments present, namely the polychaetes *Ophelia borealis*, *Nephtys cirrosa*, several species of *Spio* and crustacean from the genera *Bathyporeia* and *Urothoe*. All species identified are typical for the general area, sediment type and water depth. Epifaunal communities are sparse (ConocoPhillips, 2015).

Sabellaria spinulosa have been identified in several historical survey reports within and adjacent to the areas containing Victoria infrastructure (Conoco, 1998 and 2002; ConocoPhillips, 2005 and 2008; Venture, 2006). Whilst there is more recent evidence of *S. spinulosa*, this was however sparse and fragmented. Indications from existing reports show that there is a high probability of *S. spinulosa* across the region, even though the most recent surveys did not observe sections of *S. spinulosa* “reef habitat” (ConocoPhillips, 2015). JNCC Report No. 405 provides definitions for the classification of *S. spinulosa* “reef”. These are based on the spatial extent (must be greater than 25 m^2) and patchiness (greater than 10% coverage in an area), elevation above seabed level (greater than 2 cm in height), density of *S. spinulosa present*, biodiversity and longevity/ restoration potential (JNCC, 2007). Based on these definitions the small fragmented patches of *S. spinulosa* observed within the area including Victoria does not constitute a reef.

3.2.3 Fish & Shellfish

The Victoria infrastructure is located within International Council for the Exploration of the Sea (ICES) Rectangle 35F2. This ICES rectangle coincides with spawning grounds for cod (*Gadus morhua*; January to April), lemon sole (*Microstomus kitt*; April to September), mackerel (*Scomber scombrus*; May to August), *Nephrops* (*Nephrops norvegicus*; throughout the year), plaice (*Pleuronectes platessa*; January to March), sandeel (*Ammodytidae* sp.; November to February), sole (*Solea solea*; March to May), sprat (*Sprattus sprattus*; May to August) and whiting (*Merlangius merlangus*; February to June). The area is considered to be a part of an important spawning area for plaice, with relative high intensity spawning recorded from the ICES fish survey data (Ellis et al., 2010; Coull, et al., 1998) (Figures 3-3 and 3-4). Where areas of presence from all data sets overlap there is a greater probability that the area is a spawning ground. The Ellis et al. (2010) data provide an insight into the intensity of the spawning areas based on the data gathered from research surveys conducted within ICES rectangles in the area.

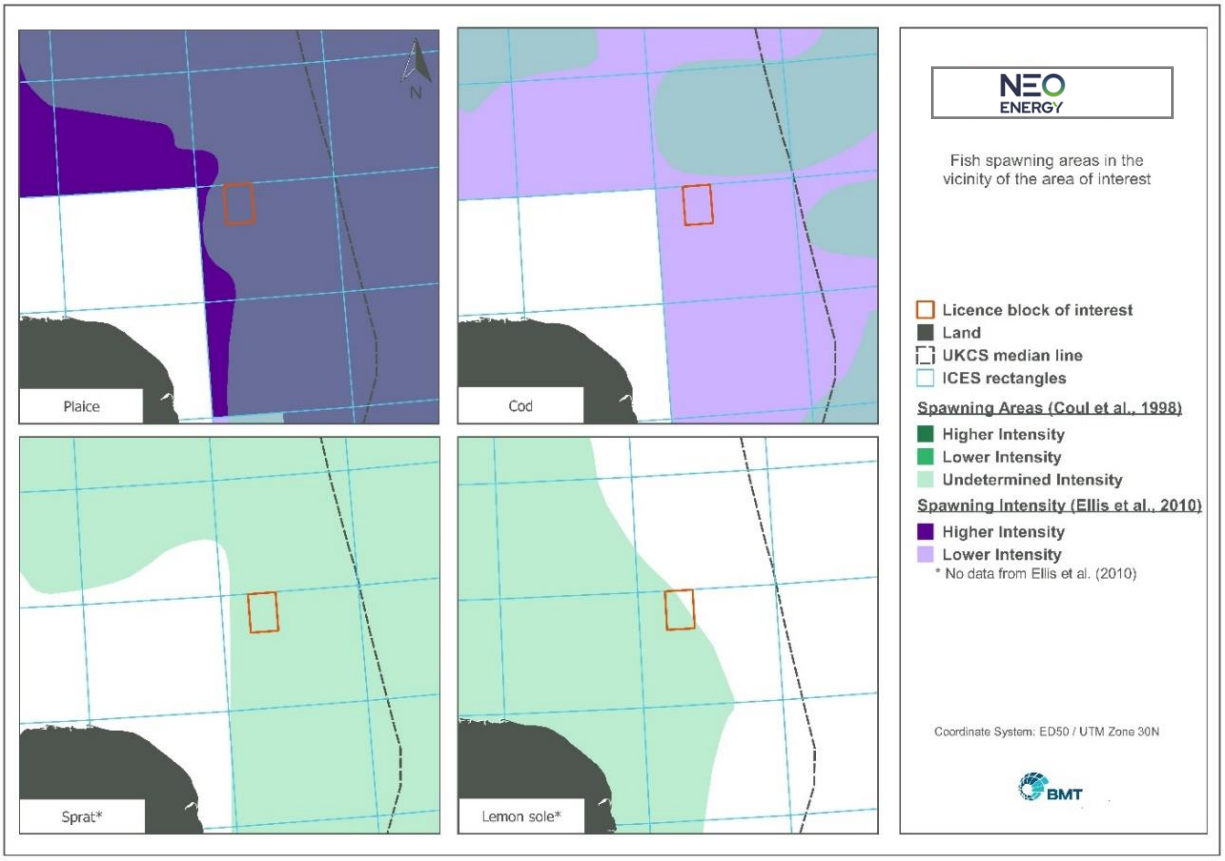


Figure 3-3: Fish spawning areas in the vicinity of the Victoria infrastructure 1/2

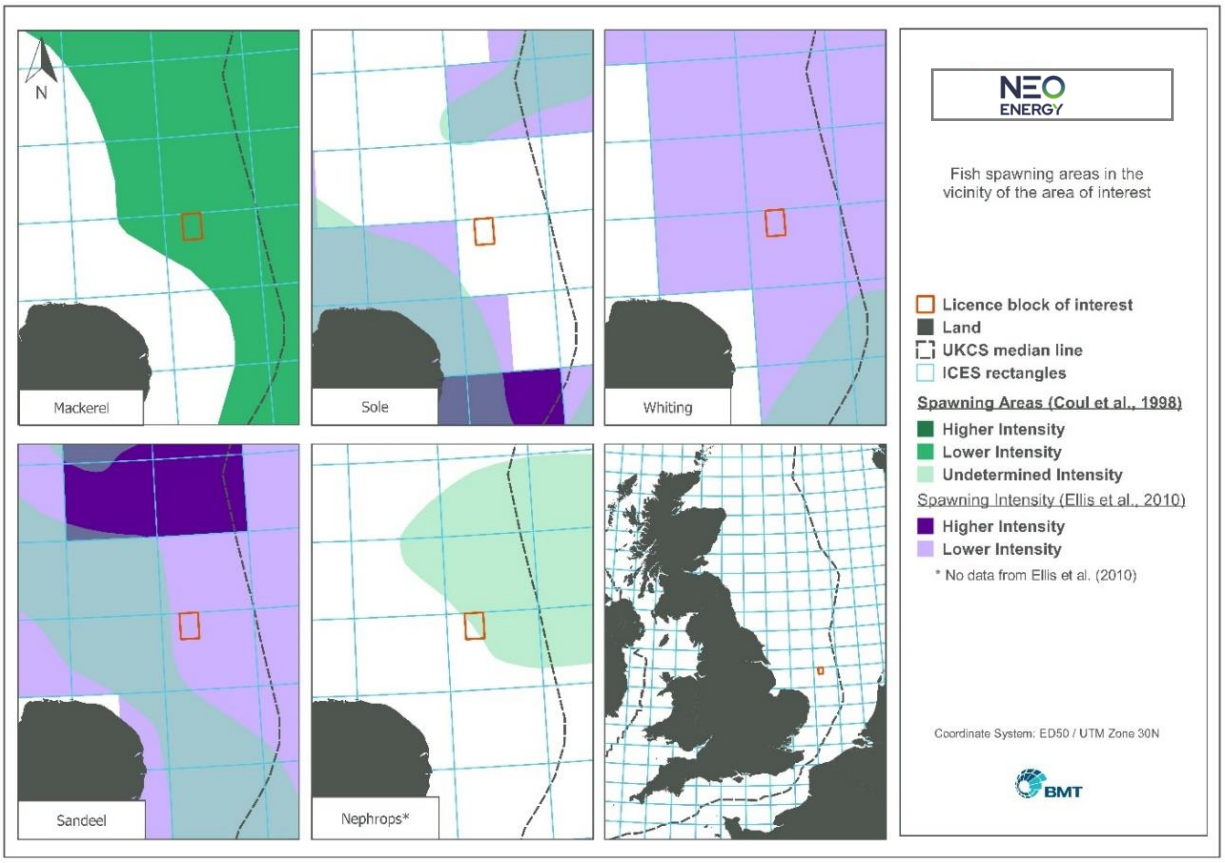


Figure 3-4: Fish spawning areas in the vicinity of the Victoria infrastructure 2/2

The Victoria subsea infrastructure also lies within the nursery grounds for cod, herring (*Clupea harengus*), horse mackerel (*Trachurus trachurus*), lemon sole, mackerel, *Nephrops*, plaice, sandeel, sole, sprat, tope shark (*Galeorhinus galeus*) and whiting (Aires et al, 2014; Ellis et al., 2010; Coull, et al., 1998) (Figures 3-5 to 3-7). These species are present throughout the year.

In the vicinity of the Victoria infrastructure, recent data indicates the probable presence of Age 0 group fish (Aires et al., 2014). Age 0 group fish are defined as fish in the first year of their lives or those that can be classified as juveniles. The predictive model for this group uses previously identified nursery grounds data from Coull et al. (1998), combined with environmental habitat variables. The results provide the probability of the presence of Age 0 group fish within areas that have defined and predictable environmental habitat specifications for the development of juveniles.

The likelihood of Age 0 group fish species in the vicinity of the Victoria infrastructure are shown within Figures 3-6-3-8, alongside data from Coull et al. (1998) and Ellis et al. (2010), which show indicative nursery grounds. Where areas of presence from all data sets overlap there is a greater probability that the area is a nursery ground. The Ellis et al. (2010) data provide an insight into the intensity of the nursery areas based on the data gathered from research surveys conducted within ICES rectangles in the area.

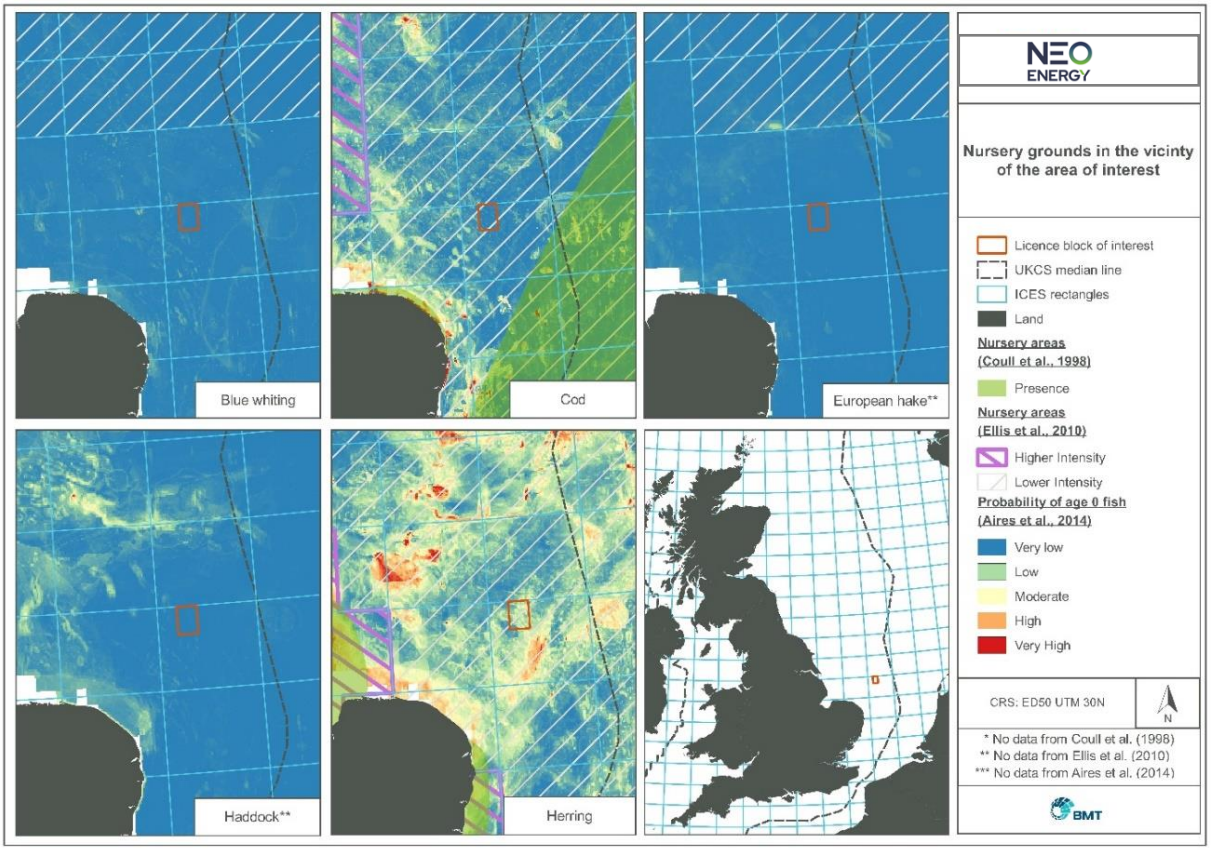


Figure 3-5: Nursery grounds in the vicinity of the Victoria infrastructure 1/3

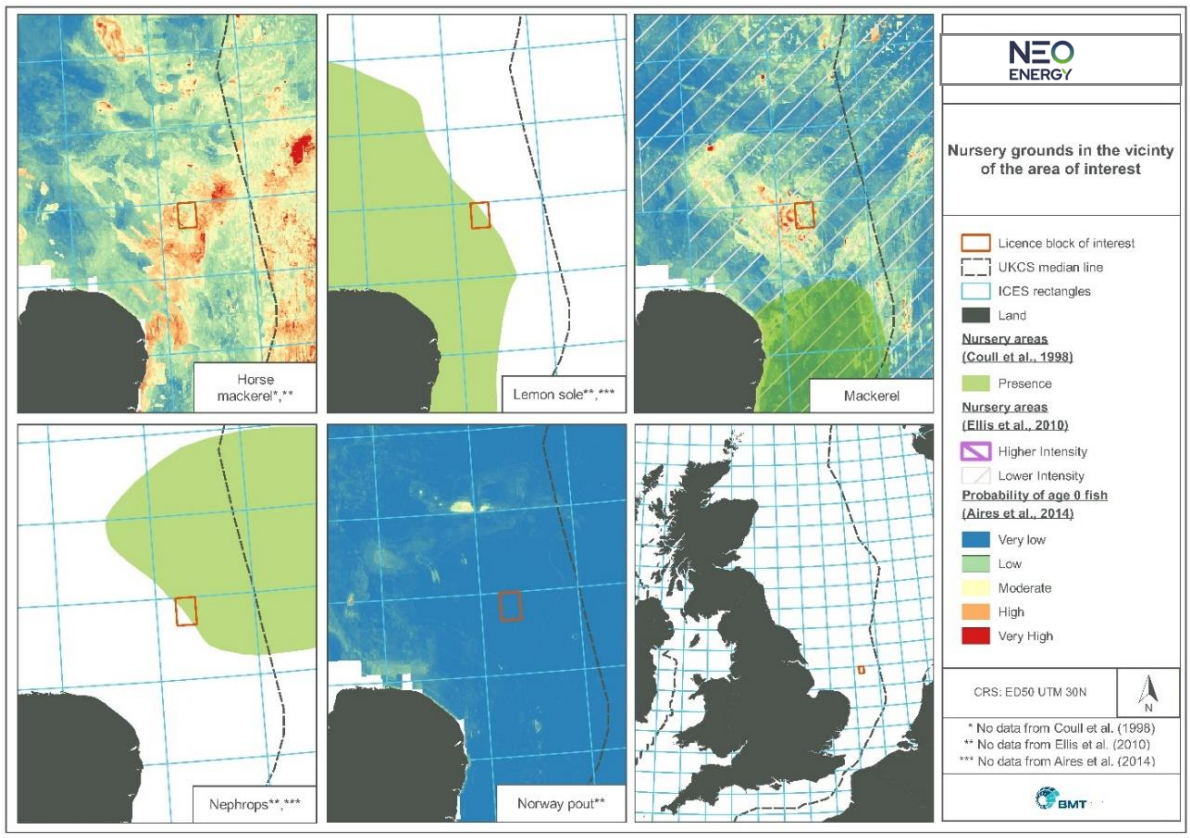


Figure 3-6: Nursery grounds in the vicinity of the Victoria infrastructure 2/3

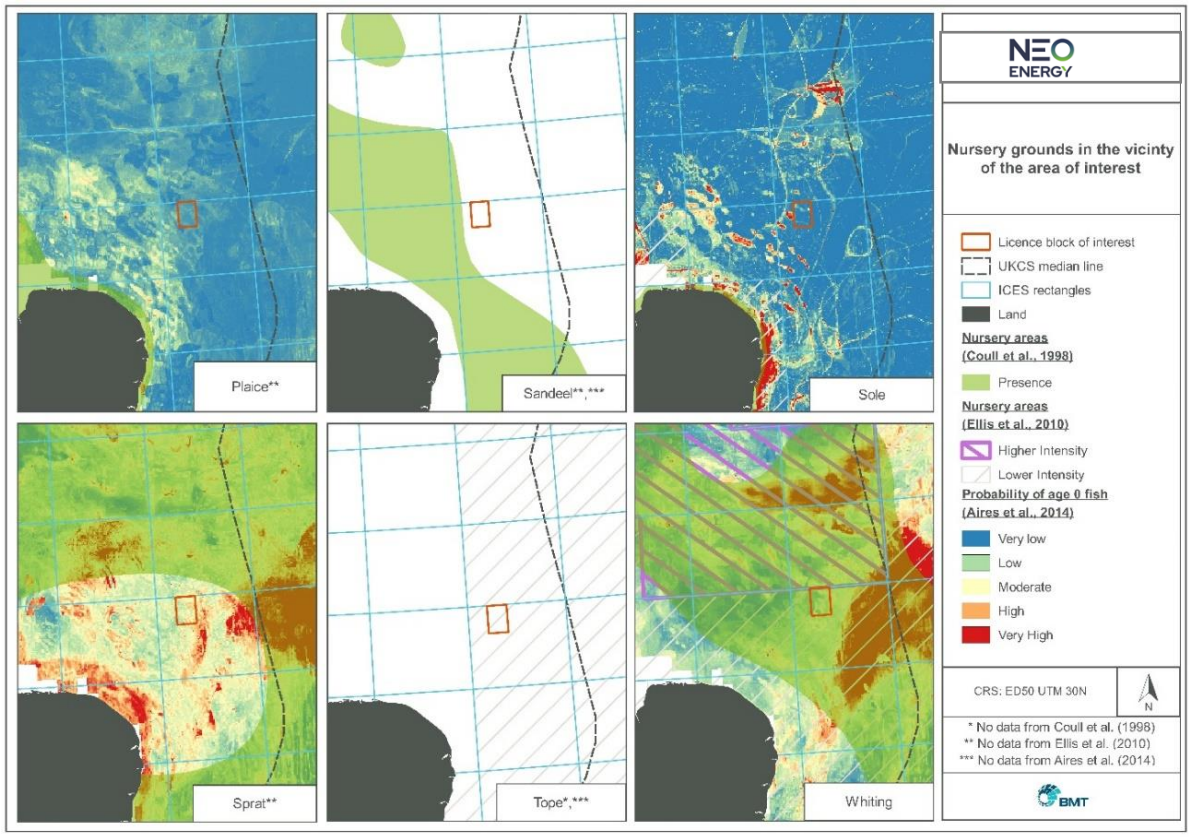


Figure 3-7: Nursery grounds in the vicinity of the Victoria infrastructure 3/3

3.2.4 Seabirds

Seabirds found in offshore North Sea waters include fulmars (*Fulmarus glacialis*), gannets (*Morus bassanus*), auks, gulls, and terns (DTI, 2001), while coastal regions accommodate their breading colonies (DTI, 2002). The Norfolk coast accommodates one of the most important breeding areas for waders, featuring estuarine shingle structures and beaches, sand dunes and salt marshes (DTI, 2002). In general, offshore areas of the North Sea contain peak numbers of seabirds following the breeding season and through winter, with birds tending to forage closer to coastal breeding colonies in spring and early summer (DTI, 2001).

The East Inshore and East Offshore Marine Plans (MMO, 2018) indicate a clear seasonality in seabird density within the decommissioning area. Throughout the year, density is typically less than 5 seabirds per km^2. This estimate is based on information from the combined work of the MMO and JNCC looking at the Special Protected Areas (SPAs) in UK waters and the 25 species that breed regularly in UK waters (MMO, 2018).

Birds are vulnerable to oiling from surface oil pollution, which can cause direct toxicity through ingestion, and hypothermia as a result of the birds' inability to waterproof their feathers. During the moulting season, certain species (e.g. guillemot, razorbill and puffin) become flightless and spend a large amount of time on the water surface, making them particularly vulnerable to surface oil pollution (DTI, 2001). However, seabirds are not normally affected by planned offshore oil and gas operations (DTI, 2001). Although locally important numbers of birds have been killed directly by oil spills, such spills have primarily been associated with the transportation of oil, and little or no direct mortality of seabirds has been attributed to exploration, production or decommissioning activities in the North Sea (DTI, 2004).

Seabird vulnerability to surface pollution varies throughout the year, with peaks in late summer after breeding when the birds disperse into the North Sea, and during the winter months with the arrival of over-wintering birds. 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), 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
- proportion of the biogeographical population in the UK

The seabird sensitivity to oil pollution in Block 49/17, where the Victoria infrastructure is located, and in surrounding blocks varies from low to extremely high throughout the year (Webb et al., 2016). The most sensitive times of year for birds in the Victoria area are February, March, July and December, with very high sensitivity within Block 49/17 in July (Table 3-1).

Table 3-1: Seabirds sensitivity to oiling in and around UKCS Block 49/17

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
49/11	1	1	1	ND	ND	1	1	5	5	ND	ND	1
49/12	ND	1	ND	ND	5	5	1	5	5	5	ND	1
49/13	5	ND	ND	ND	5	5	2	5	5	5	5	5
49/16	2	2	2	ND	ND	5	1	5	5	ND	2	1
49/17	ND	1	2	ND	ND	2	2	5	5	5	ND	1
49/18	5	ND	3	ND	5	5	2	5	5	5	5	5
49/21	1	1	2	2	ND	ND	5	5	5	ND	1	1
49/22	1	3	3	3	ND	5	5	5	3	3	1	1
49/23	3	4	4	4	ND	5	5	5	5	5	3	3

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
RED	Interpolated data
	Block of interest

3.2.5 Marine Mammals

Marine mammals include whales, dolphins and porpoises (cetaceans) and seals (pinnipeds). Marine mammals may be vulnerable to the effects of oil and gas activities and can be impacted by noise, contaminants, oil spills and any effects on prey availability (SMRU, 2001). The abundance and availability of prey, including plankton and fish, can be of prime importance in determining the numbers and distribution of marine mammals and can also influence their reproductive success or failure. Changes in the availability of principal prey species may result in population level changes of marine mammals but it is currently not possible to predict the extent of any such changes (SMRU, 2001).

3.2.5.1 Cetaceans

The main cetacean species occurring within the Victoria decommissioning area (Quadrant 49) are white-beaked dolphin (*Lagenorhynchus albirostris*) and harbour porpoise (*Phocoena phocoena*), with sightings occurring throughout the year. Further species observed in the surrounding areas include minke whale (*Balaenoptera acutorostrata*), long-finned pilot whale (*Globicephala melas*), common dolphin (*Delphinus delphis*), bottlenose dolphin (*Tursiops truncates*) and white-sided dolphin (*Lagenorhynchus acutus*) (Reid et al., 2003; UKDMAP, 1998) (Table 3-2).

Table 3-2: Cetaceans densities in Quadrant 49 and surrounding quadrants

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minke whale							L	L				
Long-finned pilot whale								L				
Bottlenose dolphin											L	
Common dolphin		L										
White-beaked dolphin	M		M	VH	L	L	L			L	L	L
White-sided dolphin								L				
Harbour porpoise		L	H	L	H	H	L	VH	H	L	M	L

KEY

	No sightings / no data	H	High densities
L	Low densities	VH	Very high densities
M	Moderate densities		

Sightings within Quadrant 49

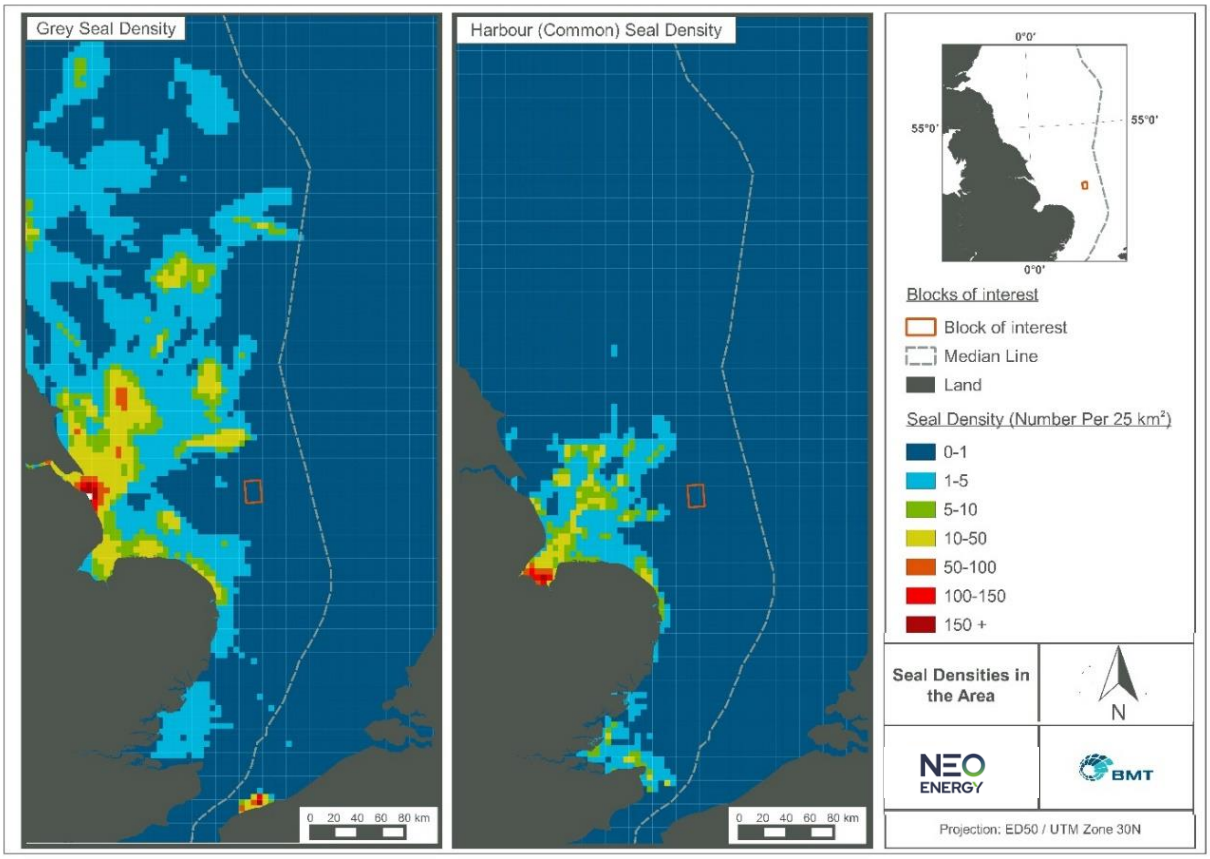
Sightings in surrounding Quadrants

Source: Reid et al. (2003); UKDMAP (1998)

3.2.5.2 Pinnipeds

The grey seal and the harbour seal are both resident in UK waters and occur regularly over large parts of the North Sea (SCOS, 2017). Density mapping (NMPI, 2018) indicates a high grey seal usage around the mouth of the Humber River and close to the Donna Nook National Nature Reserve (Natural England, 2014a). These areas contain haul-out sites, which are over 100 km from the Victoria subsea infrastructure, therefore grey seal density in Block 49/17 and surrounding blocks is very low. Between 0 and 1 grey seals per 25 km^2 could be present at any one point in time (NMPI, 2018; Figure 3-8).

Harbour seals have been observed in high concentrations in The Wash National Nature Reserve, which supports one of the largest harbour seal populations in England (Natural England, 2014b). These haul out sites are also over 100 km from the Victoria subsea infrastructure, therefore harbour seal density in Block 49/17 and surrounding blocks is very low. Between 0 and 1 harbour seals per 25 km^2 could be present at any one moment in time (NMPI, 2018; Figure 3-8).



Source: NMPI (2018)

Figure 3-8: Seal densities in the area of interest

3.3 Conservation Areas

This section presents UK conservation measures relevant to Victoria decommissioning area.

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

The European Commission (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 European Union (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, 2002). The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended) implement the EC Habitats Directive (92/43/EEC) in UK Law. These regulations apply to UK waters including offshore waters.

The UK government, with guidance from the 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 Special Areas of Conservation (SACs).

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, 2017a; Table 3-3).

Table 3-3: Annex I habitats and Annex II species occurring in UK offshore waters

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

Source: JNCC (2017a)

3.3.1.1 Annex I habitats

Within UK offshore waters there are currently 18 designated SACs, six candidate SACs (cSACs) and one cSAC/ Sites of Community Importance (SCIs); where 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 (JNCC, 2017b).

The Victoria subsea infrastructure is located within the North Norfolk Sandbanks and Saturn Reef SAC (Figure 3-9) (JNCC, 2017c). Annex I habitats occurring within this SAC include sandbanks that radiate northeast parallel to the Norfolk coast. The sandbanks typically have fields of sand waves associated with them, the amplitude of which decreases with distance from the shore. Also present are Annex I biogenic reef habitats formed by the polychaete worm *S. spinulosa* (Table 3-3; Table 3-4).

ConocoPhillips (2015) identified the presence of Annex I habitats (sandbanks that are slightly covered by seawater all the time) within the area of the Viking Development. Given the proximity of the site to the ConocoPhillips assets and the indication of sand formations in the bathymetry along the pipeline it is likely that this habitat may be present.

Recent surveys investigating the presence of *S. spinulosa* in Block 49/17a and surrounding areas did not observe evidence of *S. spinulosa* “reef habitat” (ConocoPhillips, 2015). Based on the classification of *S. spinulosa* “reef habitat” (Section 3.2.1) the small fragmented patches of *S. spinulosa* observed in the most recent surveys would not constitute a reef. More recent surveys have identified a potential reef habitat approximately 11.8 km northwest of the Victoria subsea infrastructure (JNCC, 2018).

Table 3-4: Protected areas within 40 km of the Victoria decommissioning area

Conservation site	Protected features/ distance from Victoria Field
North Norfolk Sandbanks and Saturn Reef SAC	Designated for: • Sandbanks, which are slightly covered by seawater all the time. These typically have fields of sand waves associated with them. • Annex I biogenic reef habitats formed by the polychaete worm (*Sabellaria spinulosa*) are also present. Victoria subsea infrastructure located within this SAC.
Southern North Sea cSAC	Designated for: • Annex II species harbour porpoise (*Phocena phocena*) Victoria subsea infrastructure located within this cSAC.

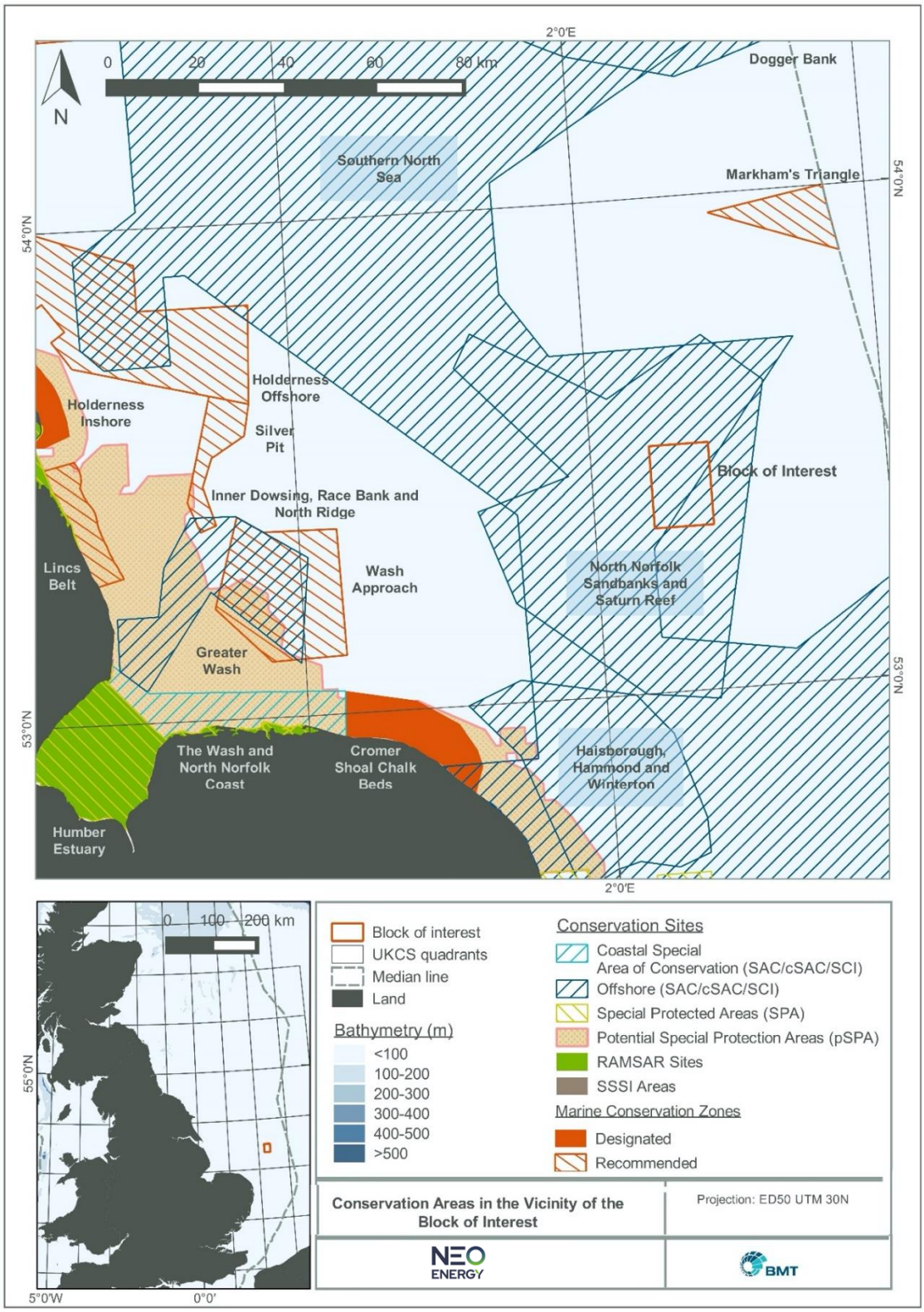


Figure 3-9: Conservation areas within the vicinity of the Victoria infrastructure

3.3.1.2 Annex II species

Annex II species sighted within the Victoria decommissioning area (Quadrant 49) include the harbour porpoise, which was sighted in high numbers in March and low numbers in February, April, May and August. In the surrounding quadrants, harbour porpoise were recorded in low to very high numbers throughout the year (with the exception of January when no harbour porpoise were observed). Low numbers of bottlenose dolphins were only sighted in the surrounding quadrants in November (Table 3-2; Reid et al., 2003; UKDMAP, 1998). Harbour and grey seal density in Block 49/17 and surrounding blocks is very low (NMPI, 2018; Section 3.3.5)

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 offshore waters (JNCC, 2017d & 2017e). 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 Victoria subsea infrastructure is located within the boundary of the Southern North Sea cSAC, selected for the protection of harbour porpoise (Figure 3-9; Table 3-4).

The harbour porpoise is highly mobile and well distributed throughout the North Sea and adjacent waters, Irish Sea and around the Scottish coast (Hammond et al., 2017) including the Block 49/17, 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).

The harbour porpoise abundance estimate in the entire North Sea from the SCANS III surveys conducted in July 2016 was 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/ km^2), elsewhere there was variation in porpoise density from 0.2 to 0.9 animals/ km^2 (Hammond et al., 2017).

3.3.2 Special Protection Areas

Special Protection Areas (SPAs) are protected sites, which have been classified in accordance with Article 4 of the EC Birds Directive. They are designated based on the location of rare and vulnerable birds and also for frequently occurring migratory species, which are listed on Annex I of the Directive.

The UK currently has 102 SPAs with marine components, with only four entirely marine. The Victoria subsea infrastructure does not transect any SPAs with marine components; however, the Greater Wash proposed SPA (pSPA) is located 69 km southwest. The Greater Wash is proposed for the protection of over-wintering Red-throated Diver, Common Scoter, Little Gull and breeding Common Tern, Sandwich Tern, Little Tern (Table 3-4; Natural England, 2017).

3.3.3 UK Marine & Coastal Access Act 2009

The UK Marine and Coastal Access Act 2009 (Marine Act) 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. The Marine Act, mainly affecting England and Wales, comprises eight key elements (JNCC, 2017e).

The Marine Act defines the arrangements for a new system of marine management across the UK. Interested organisations (such as the Marine Management Organisation; MMO) have begun preparation of Marine Plans for English waters. The English marine area has been broken up into 11 different Marine Plan areas that comprise inshore and offshore marine regions. Marine Plans for the 11 marine areas are currently being produced on a rolling programme which is expected to be complete by 2021. Marine Plans produced to date include the East (Inshore and Offshore) Marine Plans (17th December 2015). The Victoria decommissioning area (Block 49/17a) is currently located within the East Offshore marine area (MMO, 2018).

Powers in the Marine Act allow the creation of a new type of Marine Protected Area (MPA), called in English waters 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, 2017e). In Scottish waters the equivalent of MCZs are Nature Conservation MPAs (NCMPAs) (JNCC, 2017d).

A network of well-managed MPAs is being established to meet national objectives as well as the European Marine Strategy Framework Directive (MSFD), Convention on Biological Diversity (CBD) and the requirements of the OSPAR Convention to deliver an ecologically coherent MPA network in the North East Atlantic. Scottish NCMPAs and English, Welsh and Northern Irish MCZs, together with existing protected areas, will form an ecologically coherent network of well-managed MPAs in the northeast Atlantic, as agreed with international partners (Scottish Government, 2015).

To date, 50 sites have been designated within English waters. Of these, 14 MCZs have been designated in offshore waters, or cross the territorial/ offshore boundary. An additional 15 offshore recommended MCZs are being considered for designation in the southern North Sea as part of the Net Gain project. Markham's Triangle recommended MCZ is the nearest MCZ and is located 54 km northeast of Block 49/17a (Table 3-4; Figure 3-9). Markham's Triangle is recommended for the protection of coarse and sand sediment habitats which provide habitats for species including sandeels – an important food source for seabirds, seals and harbour porpoise (The Wildlife Trusts, 2017).

3.4 Commercial Fisheries

An assessment of fishing activity in the area has been derived from ICES fisheries statistics, information provided by the MMO and The Marine Analytical Unit at Marine Scotland (MMO, 2017; Scottish Government, 2018). Statistical data from ICES rectangle 35F2 on the UK fishing effort, provided by the Scottish Government (2017) and live weight of demersal, pelagic and shellfish caught by all UK vessels, provided by the MMO (2017), are reported below. The overall value of the different species by area (financial yield per ICES rectangle) is an indication of the differential worth of areas and is used as a method of expressing commercial sensitivity (Coull et al., 1998). Data have been obtained for ICES rectangle 35F2, in which the Victoria subsea infrastructure is contained (Figure 3-10).

The type of fishing gear and techniques employed by fishermen depends on a variety of factors, such as:

- Species fished, e.g. demersal, pelagic or shellfish;
- Depth of water and seabed topography; and
- Seabed characteristics.

Species found in the water column (pelagic species) are fished using techniques that do not interact with the seabed, whereas demersal and shellfish species are generally fished on or near the seabed. Finfish, such as cod, whiting, haddock and flatfish, and shellfish species, such as *Nephrops*, which are found on or near the seabed, are caught by demersal gear. Demersal trawling methods interact with the seabed and may interact with the existing infrastructure on the seabed and historical seabed anomalies created by oil and gas activities, including disturbance from subsea structures decommissioned in situ such as footings, pipelines, rock-placement or concrete mattresses left or buried in the sediment.

There are four different methods of commercial fishing recorded in the area of interest. The primary commercial fishing method is beam trawling, and secondly, bottom trawling. Table 3-5 summarises the key fishing interests by species type within the vicinity of the proposed decommissioning works.

3.4.1 Fishing Effort

The total number of days effort in ICES rectangle 35F2 was 59 days in 2014 and 85 days in 2013, with no data available for 2015 or 2016 (Scottish Government, 2017). The fishing effort in the reported years was predominantly beam trawls (Scottish Government, 2017; MMO, 2017).

3.4.2 Fishing Quantity and Value

The relative quantity and values of fish landed from ICES rectangle 35F2 in 2016 was low for demersal and shellfish species, and no reported catches for pelagic species (Figure 3-10, Table 3-5). Between 2012 and 2016, the annual total live weight of fish landed from ICES rectangle 35F2 ranged from a maximum of 151 tonnes in 2013 to a low of 36 tonnes in 2012 and total annual value from £483,111 in 2013 to £89,658 in 2012 (MMO, 2017) (Table 3-5).

3.4.3 Vessel Monitoring System Data

Vessel Monitoring System (VMS) satellite tracking data complements the ICES fisheries statistics data presented above and shows information for the years 2009 to 2013 for all UK registered commercial fishing vessels over 15 m in length (Kafas et al., 2013). To differentiate between vessels steaming and fishing, only vessels with speeds between 0 and 6 knots were assumed to be fishing. The available data is limited to *Nephrops*, demersal species, pelagic (mackerel and herring), crab, lobster, scallop and squid fisheries (Kafas et al., 2013).

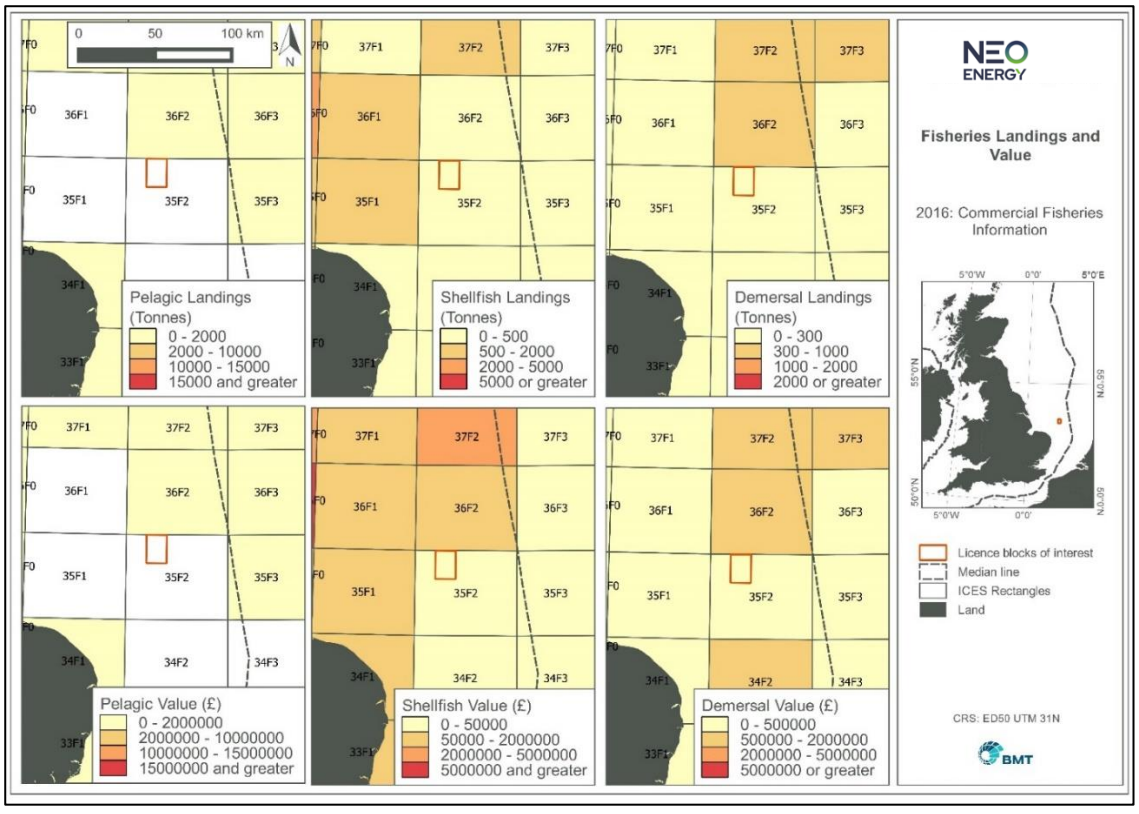
Table 3-5: Annual landings for ICES rectangle 35F2 containing Victoria infrastructure

Year	Total value (£)	Species type	Value (£)	Total quantity (tonnes)	Species type	Quantity (tonnes)
2016	366,345	Demersal	366,215	84	Demersal	84.11
		Pelagic	ND		Pelagic	ND
		Shellfish	130		Shellfish	0.03
2015	283,800	Demersal	283,654	82	Demersal	82.05
		Pelagic	ND		Pelagic	ND
		Shellfish	146		Shellfish	0.05
2014	379,667	Demersal	376,390	125	Demersal	121.32
		Pelagic	0		Pelagic	0.00
		Shellfish	3,277		Shellfish	3.79
2013	483,111	Demersal	477,082	151	Demersal	148.32
		Pelagic	ND		Pelagic	ND
		Shellfish	6,029		Shellfish	2.35
2012	89,658	Demersal	68,927	36	Demersal	28.69
		Pelagic	0		Pelagic	0.00
		Shellfish	20,800		Shellfish	7.68

Source: MMO (2017)

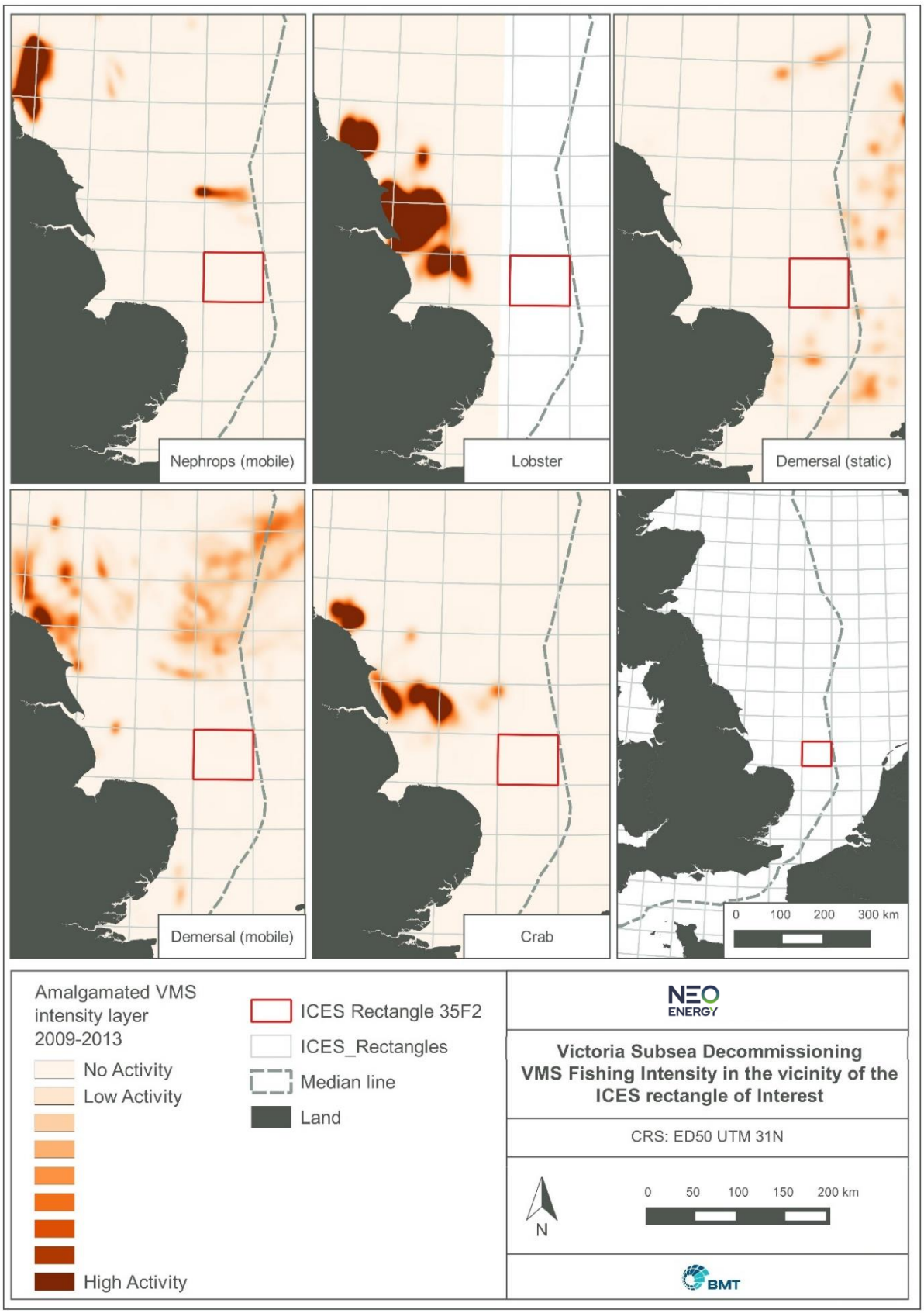
"ND" refers to no data available

The VMS data indicate the majority of fishing effort is targeted out with the decommissioning area, although the surrounding ICES rectangles show high fishing activity for crab and lobster (Figure 3-11).



Source: MMO (2017)

Figure 3-10: Relative fisheries landings and value of UK vessels over 15 m near the Victoria decommissioning area in 2016



Source: Kafas et al. (2013)

Figure 3-11: Satellite (VMS) commercial fishing landings figures for 2016

3.5 Nearby Oil & Gas Infrastructure

The Victoria subsea infrastructure are located in the SNS gas basin which is densely populated by various installations (Figure 3-12) (OGA, 2017). The platforms and other infrastructure located within 5 km from the Victoria subsea infrastructure, are listed in Table 3-6.

The area is extensively developed, therefore, other installations and associated activities may present cumulative impacts onto the surrounding environment in conjunction with the Victoria subsea infrastructure decommissioning activities, in particular on the North Norfolk Sandbank and Saturn Reef SAC.

There is one pipeline crossing area located along pipelines PL2526 and PLU2527, in close proximity to the Viking BD platform.

Table 3-6: Platforms and subsea infrastructures located within 15 km from Victoria subsea infrastructure

Platform/ Subsea structure	Distance from Victoria pipeline (km)	Direction from Victoria pipeline	Operator
Viking BD platform	0.13	SE	Chrysaor
Viking BC platform	0.27	NW	Chrysaor
Viking BA platform	0.6	NW	Chrysaor
Viking Golf platform	9.4	W	Chrysaor
Viking Delta platform	7.87	E	Chrysaor
Viking Charlie platform	7.48	SE	Chrysaor
Viking Hotel platform	10.19	N	Chrysaor
Viking lima platform	13.49	NNW	Chrysaor
Wells X 7	immediate vicinity (within 100 m)		Chrysaor
Viking Valve Skid	immediate vicinity (connected to)		Chrysaor
Pipelines X 22	immediate vicinity (within 1000 m)		Chrysaor

3.6 Other Offshore Commercial Activities

The Victoria subsea infrastructure is located within areas of Crown Estate offshore activity for aggregate production, windfarms and gas storage (Crown Estate, 2017) (Figure 3-12). The following subsections provide further detail. None of the renewables, aggregate or gas storage sites are considered to be significantly impacted by the Victoria subsea infrastructure decommissioning activities.

3.6.1 Aggregate Production

There are three minerals aggregate production areas located within 50 km of the Victoria subsea infrastructure (Table 3-3; Figure 3-12; Crown Estate, 2017).

3.6.2 Renewables

There are four known areas of windfarm development within 50 km of the Victoria subsea infrastructure (Table 3-7; Figure 3-12; Crown Estate, 2017). Three of these developments are in the pre-planning stages and one site (closest at 40 km) is under construction.

There are no areas of wave or tidal energy development in the vicinity of the Victoria subsea infrastructure area.

3.6.3 Gas and carbon capture and storage activities

As a result of declining natural gas resources in the North Sea, pressure is mounting for more investment in UK gas storage facilities to ensure integrity of supply. There is only one offshore gas storage facility currently in operation in the UK and it is located in the SNS: the Rough 47/8 Alpha facility. Other licences have been granted such as ENI's Deborah field located in Block 48/29 in the SNS, 48 km south west of the Victoria subsea infrastructure decommissioning area (Table 3-7; Figure 3-12).

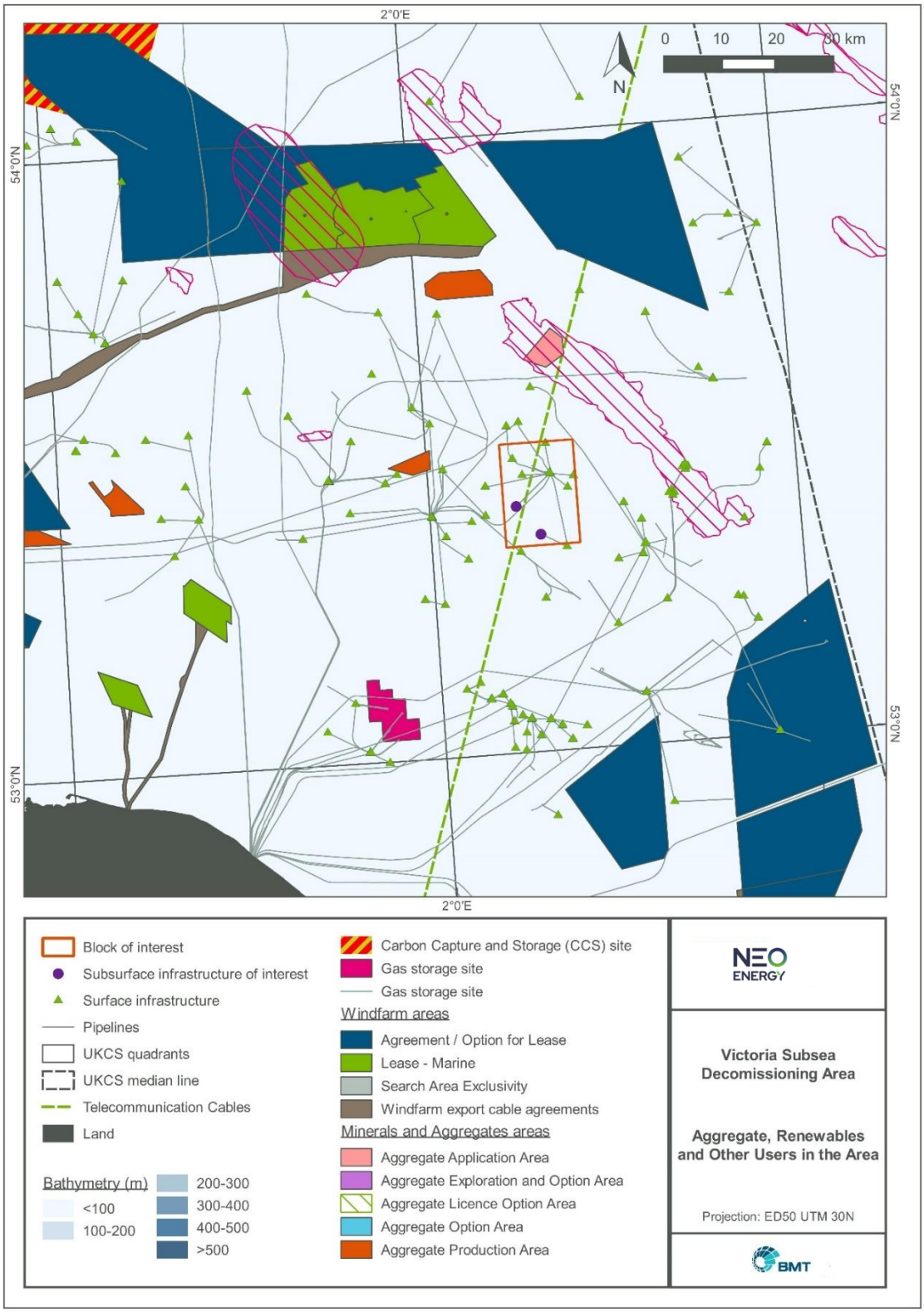
Carbon capture and storage (CCS) is a new technology being developed to manage the emissions of CO_2 and reduce the contribution of fossil fuel emissions to global warming. The closest to the Victoria decommissioning area is the Deborah project located 48 km south west (Figure 3-12). There are no known CCS plans in the immediate vicinity of the Victoria subsea infrastructure decommissioning area, although

there are aquifers present with the potential for CCS in the southern North Sea are located within Blocks 48/19, 48/20, 49/11, 49/16 and 49/17 (Crown Estate, 2017).

Table 3-7: Crown Estate activities located in the vicinity of the Victoria decommissioning area

Type of activity	Area name	Status	Block	Distance from Victoria pipeline (km)	Direction from Victoria pipeline
Windfarm	Hornsea Project Three	Pre-planning Application	49/2, 49/3, 49/4, 49/7, 49/8, 49/9	40	NW
Windfarm	East Anglia North Tranche 2 (Norfolk Boreas)	Pre-planning Application	50/21, 49/29, 49/30, 50/26, 53/4, 53/5, 54/1	48	SE
Windfarm	East Anglia North Tranche One West (Norfolk Vanguard West)	Pre-planning Application	48/28, 53/2, 53/3, 53/8	48	S
Windfarm	Hornsea Project 1 OFTO Export Cable	Live (under construction)	48/4, 48/5, 49/1,49/6, 48/10, 48/9, 48/8, 48/7, 48/6, 48/11 to shore	40	NE
Gas storage	Deborah	Agreement for lease	48/30	48	SW
Minerals aggregations	Humber 3 (484)	Production area	48/20, 49/16	21	NW
Minerals aggregations	Humber 5 (483)	Production area	49/7, 49/12	19	N
Minerals aggregations	Humber 4 and 7 (506)	Production area	49/6, 49/7	31	NW

Source: Crown Estate (2017)



Source: Crown Estate (2017)

Figure 3-12: Aggregate, renewables and other users of the sea in the vicinity of the Victoria decommissioning area

3.7 Commercial Shipping

Shipping density within the Victoria subsea infrastructure decommissioning area is very low (BEIS, 2017). The MMO has made vessel Automated Identification System (AIS) data available for 2011 and 2012. The combined AIS data images for 2012 are presented in Figure 3-13. There is a degree of vessel activity in the vicinity of the infrastructure to be decommissioned; however this is most likely attributed to vessels servicing the surrounding platforms.

3.8 Submarine Cables

The Tampnet telecommunications cable links the UK and Norway and, in addition, connects to five offshore platforms (Crown Estate, 2017). The landing points for the cable are Lowestoft in Suffolk in the UK and Kårstø, Rogaland in Norway. The five platforms that are connected to the network are Draupner platform, Ula oil field, Ekofisk, Valhall oil field and the Murdoch gas field. The cable system is currently owned by Tampnet AS.

The Tampnet cable crosses Block 49/17, 2.6 km west from Victoria subsea infrastructure.

3.9 Military Activities

There are no military activity areas within 100 km of the Victoria subsea infrastructure.

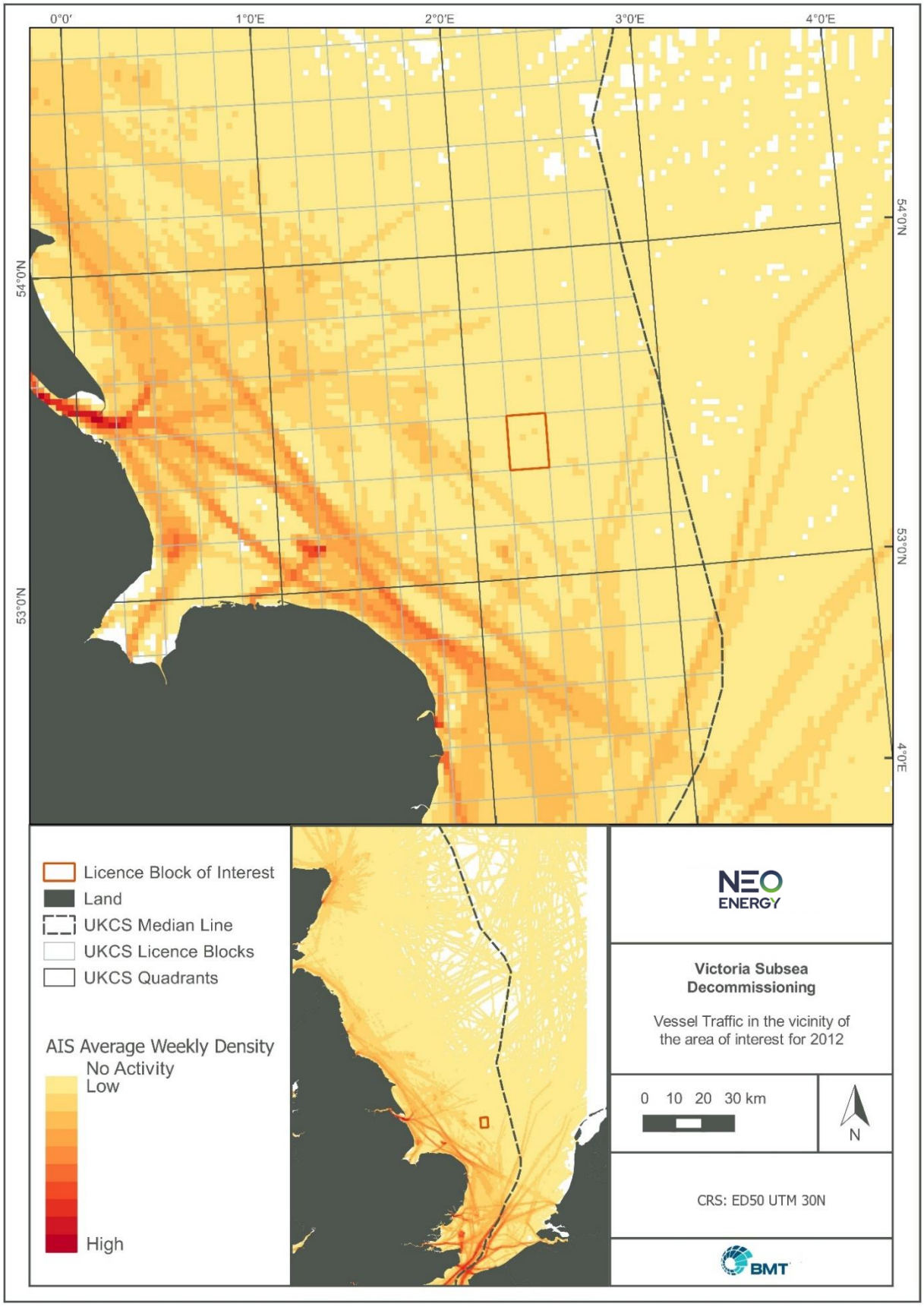
3.10 Wrecks

There are four wrecks located within the Block 49/17 (Wrecksite, 2017). None are classed as designated wrecks of historical significance, however, all four are classed as dangerous (Table 3-8). The closest to the subsea infrastructure to be decommissioned is the “East Sussex (probably)” wreck and is therefore the most likely to potentially interfere with planned decommissioning operations. The surrounding area contains numerous wrecks, both non-dangerous and dangerous, with approximately 19 in a 10 km radius around the infrastructure. NEO will ensure the appropriate actions are taken to avoid impact to these sites.

Table 3-8: Summary of dangerous wrecks present in the vicinity of Victoria decommissioning area

Wreck name	Category	Type of wreck	Distance/ direction from Victoria pipeline
East Essex	Dangerous	S Trawler	920 m SW
Tropic Shore	Dangerous	Oil rig supply vessel	3.6 km SW
Unknown	Dangerous	Trawler	4.2 km SE
Unknown	Dangerous	Unknown	7.1 km NW

Source: Wrecksite (2017)



Sources: OGA (2017), MMO (2014)

Figure 3-13: Average weekly vessel density near the Victoria decommissioning area in 2012

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 Victoria subsea infrastructure have the potential to result in an environmental impact in several different ways, including the physical disturbance of the seabed, discharges to sea and impact to other users of the sea. These effects could arise as consequences of the following aspects of the decommissioning programmes:

- General decommissioning activities
- Full removal of subsea structures
- Decommissioning pipelines in situ; and
- Pipeline flushing

An assessment of the significance of the risks to any environmental and societal receptor as a result of the operations was undertaken. The assessment looked at both planned/ unplanned operations and 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 environmental impacts 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 on this EA

The risk assessments were undertaken using the following method:

1. Each decommissioning option was broken into its component activities, operations and end-points (e.g. cutting of pipeline sections, flushing activities).
2. Receptors at risk (societal or environmental elements) 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:
   - NEO's Likelihood Matrix (Table 4-2); and
   - NEO's Consequence Severity Descriptions (Table 4-3)
5. The overall significance of risk for a particular activity was determined by the NEO's Risk Matrix (Table 4-4).

Table 4-1: Listing of environmental and societal receptors

Physical and Chemical	Biological	Societal
Seabed disturbance Water quality Air quality	Sediment biology (benthos) Water column (plankton) Fish and shellfish Sea mammals Seabirds Conservation sites	Commercial fishing Other users Legacy issues Onshore communities

Table 4-2: NEO likelihood matrix

Likelihood rating			
1	Remote	Never heard of in industry	<5%
2	Unlikely	Heard of in industry	6-20%
3	Possible	Has occurred in company	21-50%
4	Likely	Happens several times a year in company	51-80%
5	Frequent	Happens several times a year in a location	81-100%

Table 4-3: NEO consequence / severity descriptions

Consequence severity	Seabed	Water	Air	Biodiversity/ Conservation	Societal	Legacy issues
1 (Incidental)	Physical disturbance, short-term or localised impacts not affecting usage.	Slight degradation of quality or reduction of volume of groundwater. Slight contamination of aquatic ecosystem.	Measurable deterioration of ambient air quality at specific area and fence-line community. No odour or irritation to fence-line community caused by the deterioration of air quality.	Slight impact on localised species and habitat. Effects are unlikely to be discernible or measurable.	Some awareness within community.	Majority of recovered material recycled or re-used. No hazardous waste requiring long-term storage. No change to habitat or species composition (no introduction of new materials). No material left on OR in the seabed.
2 (Minor)	Localised physical disturbance and/ or chemical pollution which may affect user. Effect will remediate naturally in a short period (<1 year).	Minor degradation of groundwater quality or reduction of its volume. Minor contamination of aquatic ecosystem.	Measurable deterioration of ambient air quality on the local level. Minor odour and irritation to local community caused by deterioration of air quality.	Changes to habitats or species which can be seen and measured but is at same scale as natural variability.	Minor concern raised within community. Short-term intermittent disturbance from traffic and noise. No impact to human health from decommissioning activities.	Majority of recovered material reused or recycled. Non-hazardous waste required treatment or disposal (landfill) OR Small amount of hazardous waste requiring treatment and/ or long term-storage. Possible/ temporary alteration of species composition due to habitat alteration with recovery and recolonisation of the area by original species. Inert material left in OR on the seabed (leaving material but not expected to have environmental impact, i.e. Best Environmental Practice (BEP)).
3 (Moderate)	Physical disturbance and/ or chemical pollution resulting in limitations to the use of the area. Effect/ impact can be for a period of years, but does not require remediation/ mitigation.	Considerable degradation of groundwater quality or reduction of its volume. Considerable contamination of aquatic ecosystem.	Measurable deterioration of ambient air quality on a regional level. Considerable odour and irritation to neighbouring community caused by deterioration of air quality.	Widespread change in habitats or species beyond natural variability.	Considerable concern raised within community. Some complaints from community. Frequent disturbance from traffic and noise. No impact to human health from decommissioning activities.	Some of recovered material destined for landfill (less than 50%). Small amount of hazardous waste requiring treatment and/ or long term-storage. Alteration of species composition due to habitat alteration with recovery and recolonisation of the area by original species. Inert material left in OR on the seabed (leaving material expected to have minor/ short term environmental impact).

Consequence severity	Seabed	Water	Air	Biodiversity/ Conservation	Societal	Legacy issues
4 (Major)	Physical disturbance and/ or chemical pollution resulting in limitations in the use of the area. Remediation/ mitigation measures needed.	Major degradation of groundwater quality or reduction of its volume. Major contamination of aquatic ecosystem.	Measurable deterioration of ambient air quality on a national level. Acute impact from odours on local receptors.	Widespread degradation to the quality or availability of habitats or species.	Major concern raised within community. Many complaints from community Frequent disturbance from traffic and noise. Some impact to human health from, for example, sleep disturbance.	Between 50% and 75% of recovered material destined for landfill. Long-term ecological effect. Inert material left in OR on the seabed (leaving material expected to have some short to mid-term environmental impact). Moderate amount of hazardous waste requiring treatment and/ or long term-storage. Potential risk posed to other uses of the sea.
5 (Severe)	Physical disturbance and/ or chemical pollution resulting in restricted use of the area. Remediation is difficult, costly and over an extended period.	Catastrophic degradation of groundwater quality or reduction of its volume. Catastrophic contamination of aquatic ecosystem.	Measurable deterioration of ambient air quality on an international level. Severe acute impact on the receptor(s) (human and living thing) potentially leading to fatality.	Widespread degradation to the quality or availability of habitats and species that cannot be readily rectified.	High profile community outrage - protest and insurgence. Disturbance from decommissioning activities resulting in impacts to livelihood, employment and/or restriction to amenities. Quantifiable impact to human health with possibility of increased fatalities.	Majority of recovered material destined for landfill. Majority of hazardous waste requires treatment or long-term storage. Permanent habitat alteration with permanent changes in species composition. Material left on OR in seabed with potential environmental impact (hydraulic fluids, plastic, etc.). Risk posed to other uses of the sea.

Table 4-4: NEO risk & impact matrix

Consequence severity	Likelihood				
	1	2	3	4	5
1 (Incidental)	1	2	3	4	5
2 (Minor)	2	4	6	8	10
3 (Moderate)	3	6	9	12	15
4 (Major)	4	8	12	16	20
5 (Severe)	5	10	15	20	25

	Low Risk, Score 1-4 (Not Significant) – Risk acceptable if managed but controls need to be reviewed in light of any changes (e.g. in technology)
	Medium Risk, Score 5-12 (Significant) – Risk only tolerable if all possible control actions taken and no risk reduction/ control measures will reduce risk further
	High Risk, Score 15-25 (Highly Significant) – Cannot remain in this area without Management Team approval. Apply risk reduction/ control measures even if major cost/ effort required. In some cases fundamental changes may be required to the method by which the operation is to be conducted

4.2 Risk Assessment Findings

A summary assessment is provided in Table 4-5, while detailed outcome of the risk assessment with the significance assigned to the decommissioning activities is presented in Table 4-6. The left-hand column of the detailed table identifies those activities associated with the Victoria 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 environmental (physical, chemical, biological) and societal receptors. The final two right-hand columns of the table present the overall assessed risk category and the sections of the EA 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 no activities identified as high risk. Several of the expected decommissioning activities have been identified as a potential medium risk to receptors. These risks are assessed further in Sections 5 to 8:

- Seabed impact (Section 5);
- Discharges to sea (Section 6);
- Societal impacts (Section 7);
- Accidental events (Section 8); and
- Underwater noise (Section 9).

Where stakeholder concerns have been raised (Table 1-2), these have also been considered within Sections 5 through to 9. Underwater noise scored low in the risk assessment, however is further considered due to stakeholder concerns (Section 9).

For the impacts or risks that were considered to be low, Table 4-6 provides the justification for excluding these potential impacts and risks from further investigation in the EIA.

Table 4-5: Summary of total number of risk categories associated with Victoria decommissioning activities

Decommissioning activities	Risk categories					
	Low		Medium		High	
	Planned operations	Unplanned operations	Planned operations	Unplanned operations	Planned operations	Unplanned operations
General decommissioning activities	10	1	2	1	0	0
Full removal of subsea structure	2	0	3	0	0	0
Decommissioning pipelines in situ	0	0	4	0	0	0
Pipeline flushing	0	0	1	0	0	0

Table 4-6: A risk assessment results associated with Victoria decommissioning activities

	Physical			Biological						Societal					
	Seabed disturbance	Water quality	Air quality (local)	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Other users	Legacy issues	Onshore communities (resources)	Median risk value (R)	Justification for exclusion from further assessment/ Section Reference
General decommissioning activities – applicable to all activities															
Planned operations															
Physical presence of vessels (incl. mob/demob/transit and working on site)										4	2			3	Shipping/ fishing traffic can readily navigate round the individual vessels as they travel to and from the offshore site. Notifications of planned activities will be issued.
Jack-up rig deployment (well P&A support)	8	2		5	5	5	5		5					5	Section 5
Underwater noise from associated vessels operations						3	6		4	2				4	Section 9
Operational discharges of treated oily bilge		5			2	2		2						2	Any discharge will be within permitted limits.
Sewage and grey water discharges		2			2	2	2							2	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		2			2	2	2							2	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 on site		2		2	2	2	2		2			2		2	NEO'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.
Atmospheric emissions from vessels			4											4	The emissions will be a small-scale contributor of greenhouse gases and

	Physical			Biological						Societal					Justification for exclusion from further assessment/ Section Reference
	Seabed disturbance	Water quality	Air quality (local)	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Other users	Legacy issues	Onshore communities (resources)	Median risk value (R)	
General decommissioning activities – applicable to all activities															
															other global gases (Section 2.7). The atmospheric emissions will disperse in the exposed offshore environment.
Reuse/recycling of material			4										4	4	Minimal impact on onshore resources due to small volume of material.
Waste management of hazardous material												3	4	4	No hazardous waste anticipated other than marine growth.
Waste management of non-hazardous material												3	4	4	Minimal amount to landfill.
Overtrawlability surveys	10	4		5	5	5	5		5	2				5	Section 5
Unplanned															
Dropped objects	1													1	The area of seabed that will be impacted will be small and localised. All impacts will be temporary. Debris (including any dropped objects) will be recovered.
Vessel to vessel collision		8			6	6	6	8	6	5	5	6	6	6	Section 7 and 8
Full removal of subsea structures (pipeline ends, mattresses, spools well head/ trees etc.)															
Planned operation															
Structure separation and cutting (plasma, flame or cold cutting)	3	3		3	3	3	2		2	1	1			3	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. Even in open water, cutting tool use is generally out with the hearing range of most cetaceans. Tool use tends intermittent and for short duration.
Underwater cutting of piles 3 m below seabed	5	4		5	5	5	5		5	2	2			5	Section 5
Recovery of subsea material (mattress, spools, trees, etc.)	5	5		5	5	5	5		5	2	2			5	Section 5
Release of contaminated fluids/material		5		5	5	5	5	3	5	2		2		5	Section 6
Dismantling structures/ recovery of materials onshore												2	2	3	Any cleaning required will be done by a specialist

	Physical			Biological						Societal					Justification for exclusion from further assessment/ Section Reference
	Seabed disturbance	Water quality	Air quality (local)	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Conservation sites	Commercial fishing	Other users	Legacy issues	Onshore communities (resources)	Median risk value (R)	
General decommissioning activities – applicable to all activities															
															contractor and include use of bunded areas. Minimal amount to landfill.
Decommissioning pipelines in situ - opened ends of pipeline reburied, no rock-placement															
Planned operations															
Physical presence of *in situ* pipelines										10	4	10		10	Section 7
Dredging/trenching operations to excavate pipeline at ends and rebury (diver operated)	10	4		10	5	5	5		5	2				10	Section 5
Release of contaminated fluids		5		5	5	5	5	3	5	2		2		5	Section 6
Residual contaminants released from degrading pipelines decommissioned in situ	5	5		5	4	5	4		5	2		2		5	Sections 5 & 6
Pipeline Flushing - Use a vessel to vent the pipeline to sea at Victoria valve manifold, and allow free flood from Victoria. Relocate vessel to Viking BD skid and flush remaining contents to sea.															
Planned Operations															
Release of contaminated fluids/material		5		5	5	5	5	3	5	2		2		5	Section 6

5 Seabed Impacts

This section discusses the potential short- and long-term environmental impacts associated with seabed disturbance resulting from the proposed Victoria decommissioning activities. The measures planned by NEO to minimise these impacts are detailed in Section 5.8.

5.1 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.

5.2 Approach

The Victoria decommissioning activities will require work below, at or near the seabed, which may result in either short- or long-term disturbance to the seabed sediments and associated marine organisms. The extent of any disturbance, combined with the seabed type and hydrodynamic conditions during the activities, will determine the burial and smothering extent from suspended sediments and any direct impact to species or habitats, as described in Table 5-1.

Table 5-1: Summary of potential sources of seabed disturbance and resultant environmental impacts

Decommissioning activity	Environmental impact		
	Suspended sediments	Release of contaminants	Burial and smothering
Jack-up rig deployment	short-term	-	short-term
Overtrawl surveys	short-term	-	short-term
Underwater cutting of piles 3 m below seabed	short-term	-	short-term
Recovery of subsea material	short-term	short-term	short-term
Dredging/ trenching operations to excavate pipeline at ends and rebury	short-term	-	short-term
Residual contaminants released from degrading pipelines decommissioned *in situ*	-	long-term	-

5.3 Source of Potential Impacts

The following activities represent worst-case scenarios that will potentially impact the seabed at the Victoria field:

- Positioning of a jack-up rig during well P&A and preparatory activities (short-term impacts);
- Dredging/ trenching operations to excavate pipeline at ends and rebury (short-term impacts);
- Excavating and cutting operations of underwater piles 3 m below seabed (short-term impacts);
- Recovery of subsea materials, such as mattress, spools, trees, manifolds (short-term impacts);
- Slow release of contaminants from pipelines decommissioned in situ as they degrade over time. The source of the contamination would be the degradation products of the pipeline, any entrained heavy metals and any hydrocarbons or heavy metals associated with residual solids (long-term impacts); and
- Overtrawl surveys undertaken post decommissioning to ensure seabed is clear of obstructions. The overtrawl trials are usually undertaken with a version of the (Scottish Fisherman's Federation) SFF overtrawl gear, which is a steel mesh net trawled over the seabed that will snag on any obstructions and flatten any seabed features which have presented themselves as a result of decommissioning activities, such as mud berms (short-term impacts).

Structures and materials to be removed as part of Victoria decommissioning activities and the approximate seabed area of disturbance of the North Norfolk Sandbanks and Saturn Reef SAC are presented in Table 5-2. It is recognised that the Victoria infrastructure is also within the Southern North Sea cSAC, however, as the designation of this cSAC is primarily for the conservation of harbour porpoise, seabed impact is not considered to have an impact on the protected species. As previously discussed, the decommissioning programmes will leave the pipelines in situ and result in the release of a small volume of chemical contaminants as the steel pipelines, their coatings and any residual scale degrades. However, this will be a gradual release of small quantities over a long period of time.

5.3.1 Positioning of Jack-up Rig

Both the seabed sediments and benthos will be impacted by the deployment and placement of the jack-up rig. Upon commencement of preparatory and P&A operations, the rig will be located to its working position adjacent to the Victoria well. There will be a seabed impact from the jack-up spudcans. At this stage the decision on the exact jack-up rig to be used is not finalised, therefore, the use of four-legged jack-up is included as the worst case scenario. The need for anchoring or use of stabilisation materials is not anticipated for the Victoria decommissioning project, due to the location in the protected site.

The worst-case seabed disturbance associated with the rig positioning is presented in Table 5-2.

Table 5-2: Structures and materials with the potential to impact on the seabed

Item placed/ removed from the seabed	Dimensions	Seabed impact (km^2)
Spudcans	4 spudcans x 22 m^2	0.00009
Victoria wellhead protection structure	4 legs x area of 0.79 m^2 each	0.00000316
Victoria valve skid	11.2 m long x 6 m wide	0.00007
Victoria valve skid piles	4 piles x 0.61 m diameter	0.0000003
Pipeline spools and ends	261 m (total length of pipeline spools and ends for removal) x 5 m (width of affected corridor)	0.00130
Umbilical spools and ends	270 m (total length of umbilical spools and ends for removal) x 5 m (width of affected corridor)	0.00135
Concrete mattresses	109 mattresses x 6 m long x 2.4 m wide	0.00157
Frond mattresses	13 mattresses x 6 m long x 2.4 m wide	0.00019
TOTAL		**0.00457**

Source: Verus Petroleum (2018a)

5.3.2 Excavate Pipeline & Umbilical Ends & Rebury

Where pipeline and umbilical ends are already buried or partly buried, the ends will be excavated (dredged/ trenched) to allow cutting and removal of the spools. Sediment will be excavated by a work class ROV and jetting tools and will be deposited downcurrent where it will undergo natural dispersal. The pipeline ends will then be covered to a depth of 0.6 m above the top of the pipeline and any remaining trench will be actively reburied. The dredging and trenching operations at this scale would be expected to physically disturb the seabed sediments and benthos local to the pipeline ends.

The seabed disturbance associated with the pipeline ends removal is estimated to be 0.0027 km^2 (Table 5-2).

5.3.3 Excavating & Cutting Operations of Underwater Piles

The Victoria valve skid in each of the four corners is secured by piles, 610 mm in diameter and 25.4 mm wall thickness. Piles will be excavated and cut using high pressure water abrasive and removed to approximately 3 m below the seabed. A total of 24 m of piles will be removed (three metres above seabed, three metres below seabed, four piles). During excavation, sediment would be excavated by a work class ROV and would be deposited downcurrent to undergo natural dispersal with minimal/ short-term impact on the surrounding seabed area.

The direct impact associated with cutting and excavation of the underwater piles will create a short-term disturbance of the seabed sediments and benthos, over an estimated area of 0.3 m^2 (Table 5-2).

5.3.4 Recovery of Subsea Materials

NEO intends to remove the Victoria valve skid, wellhead and protection structure, spools and mattresses within the Victoria field and those NEO has responsibility for in proximity to the Viking facilities. Removal of the subsea materials will result in habitat change and disturbance to the benthos inhabiting the structures and the immediately adjacent sediment.

The seabed disturbance associated with the removal of the subsea materials is 0.00448 km^2 (Table 5-2).

5.3.5 Pipeline Residual Contaminant Release

Both PL2526 and PLU2527 are trenched and buried and will be decommissioned in situ. Structural degradation of the pipeline and umbilical will be a long-term process caused by corrosion, and eventual collapse, of the pipelines under their own weight and that of the overlying sediment. During this process, degradation products derived from the exterior and interior of the pipe and umbilical will breakdown and potentially become bioavailable to benthic fauna in the immediate vicinity. Pathways from the pipelines to the receptors would be via the interstitial spaces in seabed sediments. These discharges are further discussed in Section 6.

5.3.6 Clear Seabed Surveys

Due to sensitive environmental setting in the Victoria area differing methods of verification of the seabed state will be undertaken, this may include trawling over sites where actual decommissioning activities occurred and alternative methods along undisturbed pipeline corridor. The appropriate methods will be discussed and agreed with OPRED, in due course. There largest area of disturbance would be attributed to the overtrawl survey, which needs to be conducted to ensure the seabed is safe for other users of the sea and is a requirement under the BEIS guidance. The potential for an impact relates to the overtrawl trial undertaken with a version of the SFF overtrawl gear consisting of a steel mesh net, which is trawled over the seabed and will snag on any obstructions and flatten any seabed features which have presented themselves as a result of decommissioning activities, such as mud berms (short-term impact). As the worst-case scenario, the survey would cover an area of approximately 0.024 km^2 (a corridor approximately 475 m long and 50 m wide on each side of the pipeline, encompassing all removed infrastructure and pipeline crossing).

5.4 Short & Long-Term Impacts

The seabed impacts resulting from the decommissioning activities associated with the Victoria decommissioning can be classified as short- or long-term. Short-term impacts are defined here 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.

5.4.1 Short-Term Impacts

Seabed impacts from placing jack-up spudcans, excavation and cutting of pipeline ends, excavation and cutting piles, recovery of subsea materials and overtrawlability surveys will be transient and will have a short-term impact to the local benthic environment in the Viking decommissioning area. The likely temporary impacts arising from these activities can be summarised as:

- Sediment disturbance; and
- Benthic fauna disturbance.

5.4.2 Long-Term Impacts

Long-term impacts relate to the physical/ chemical breakdown of the pipeline and umbilical decommissioned in situ. The likely long-term impacts arising from these can be summarised as:

- Sediments morphological change; and
- Benthic fauna disturbance.

5.5 SHORT-TERM IMPACTS ON SENSITIVE RECEPTORS

The following sections provide an overview of the spatial and temporal extent of the short-term impacts based on the current understanding of the seabed environment in the North Norfolk Sandbanks and Saturn Reef SAC.

5.5.1 Sediments Disturbance

The dynamic seabed environment of the North Norfolk Sandbanks and Saturn Reef SAC is characterised by large and small sand waves, megaripples, and small exposed shoal areas. The sediments in the Victoria decommissioning area are classified as very poorly to moderately well sorted, fine sand to fine gravel with low content of silt/ clay and organic matter (Section 3). Low content of silt and clay in the sediment indicates the dynamic nature of the seabed in the area.

The disturbance due to pile excavation work will be relatively localised and occur due to the seabed excavation (where required), the ROV manoeuvring, and the use of cutting equipment. The proposed activities will cause some direct impact to fauna living on and in the 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.

Overtrawl survey work will physically disturb the benthic fauna living on or in the sediment through a trawl across the area of interest. This short-term impact would be expected to pose minimal effect on the SAC as the activity is similar to that caused by current fishing practices, of which the wider area is subject to. This impact is also not anticipated to be significantly different to a large winter storm, which in shallow seas such as those found at the Victoria decommissioning area, which would result in the movement and distribution of seabed and existing features. The disturbance to the benthic fauna will be short-term and confined to the survey area.

Due to the sensitive environmental setting and presence within the North Norfolk Sandbanks and Saturn Reef SAC, the use of an alternative, non-invasive, method of debris clearance along all pipeline corridor and for areas where decommissioning work has directly taken place, will discussed with OPRED. However, for the purpose of this assessment a worst-case scenario, were classic overtrawlability trials are conducted, has been considered.

Sediments that will be redistributed and mobilised as a result of the proposed decommissioning activities will be transported by the nearbed currents before settling out over the adjacent seabed areas. The hydrodynamic conditions (Section 3.1.3) will result in suspended sediment, in particular any finer 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), which comprises up the majority of the sediment in the area (Section 3.1.7), 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.

In such a mobile area, the expected sediment recovery time from removal and/ or excavation activities is approximately eight months, as demonstrated by Hill et al., (2011) who observed that areas of dredging on sandbanks which are subject to naturally high sediment mobility may disappear within a few tidal cycles where adequate sediment is available to supplement this. Infrequent, high-energy (storm) conditions will also result in sediment suspension and redistribution. Published calculations of wave and tidal current-induced bed shear stress clearly show that large waves have the capability to mobilise seabed sediments (ABPmer, 2012).

The proposed excavation, cutting, removal, spudcans placing and survey operations will physically disturb the sediment in the local area. The seabed sediment disturbance will be short-term, localised and confined to an estimated area of impact of, approximately, 0.029 km^2(0.005 km^2 and 0.024 km^2). This represents 0.0.0008% of the total area of the SAC (3,603 km^2; JNCC, 2017c).

5.5.2 Benthic Fauna Disturbance

The proposed activities will physically disturb the benthic fauna living on and in the sediments in the local area. The disturbance to benthic fauna will be short-term, localised and confined to an estimated area of impact of, approximately, 0.0.029 km^2. This represents a small portion of the total area of the SAC (0.0.0008% of 3,603 km^2; JNCC, 2017c).

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 so be able to return once operations have concluded. Upon completion of the subsea decommissioning activities, it is expected that the resettled 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 Victoria decommissioning 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)). Therefore, biological recovery is expected to be even quicker in less extensive, dynamic sandy habitats (Hill et al., 2011) such as those observed at the Victoria 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, 2011). Based on the dynamic seabed characteristics in the Victoria decommissioning area, recovery would be expected to be at the shorter end of this scale.

A small number of demersal and pelagic fish and their spawning grounds might also be temporarily disturbed by the decommissioning activities. There are potential fish spawning areas in ICES rectangle 35F2 for cod, lemon sole, mackerel, *Nephrops*, plaice, sandeel, sole, sprat and whiting (Section 3.2.3) (Coull et al., 1998; Ellis et al., 2012).

5.6 Long-Term Impacts on Sensitive Receptors

The following sections describe the footprint of the existing pipeline and the long-term impact from release of the contaminants as pipeline degrades over time.

5.6.1 Benthic Fauna Disturbance

Structural degradation of the pipeline and umbilical in the Victoria area will be a long-term process caused by corrosion and the eventual collapse. Since the umbilical is primarily made up of plastics, it will likely take longer to degrade. During this process, degradation products derived from the exterior and interior of the pipe and umbilical will breakdown and potentially become bioavailable to benthic fauna in the immediate vicinity. Pathways from the pipeline and umbilical to the receptors would be via the interstitial spaces in seabed sediments, overlying rock-placement where applicable and the water column. Any failure is anticipated to begin to occur after many decades and is expected to take up to several hundreds of years to fully degrade. The release of degradation products is expected to occur at a slow rate, therefore, expected to have a minimal impact on the surrounding environment.

The primary degradation products will originate from the following pipeline and umbilical components:

- Residual scale
- Steel
- Sacrificial anodes
- Plastic

The following sections outline the degradation products associated with each of these components. The potential impacts of the release of these products on benthic fauna and ecosystems are also addressed below. The impacts of the products (hydrocarbons and chemicals) released to sea during the flushing and degradation of the pipeline and umbilical are addressed in Section 6 (Discharges to Sea).

The rate of external corrosion of an abandoned pipeline can vary significantly due to the many factors which must be present for corrosion to take place. Corrosion of subsea buried pipelines will occur through an electrochemical reaction that involves the loss of metal in one location (called the anode) through the transfer of the metal ions to another location on the pipeline (called the cathode). The anodes will corrode preferentially to the pipeline material. However, once these are depleted, the pipeline material will corrode.

5.6.1.1 Heavy metals

Metals with a relatively high density or a high relative atomic weight are referred to as heavy metals. It is expected that these metals will be released into the sediments and water column during the breakdown of the components of the pipeline scale, steel and sacrificial anodes.

The chemical components of the pipeline and umbilical are shown in Tables 5-3 and 5-3, respectively. The bulk constituent of the steel is iron (98.1899 – 99.9999 %).

Table 5-3: Pipeline steel (API 5L-X65) chemical components

Element	Composition (maximum %)
Iron (Fe)	Bulk
Manganese (Mn)	1.65
Carbon (C)	0.16
Phosphorus (P)	0.020
Sulphur (S)	0.010
Titanium (Ti), Niobium (Nb), Vanadium (V)	Combined (<0.2)

Table 5-4: Umbilical chemical components

Material	Approximate Composition (maximum %)
Plastics	70
Metal	26
Other (string filler)	4

The pipeline was cathodically protected with 33 pairs of aluminium-zinc anodes. The cathodic protection system operates on the principle that the anodes will decay in preference to the pipeline material. A typical composition of an aluminium-zinc anode used in the North Sea is provided in Table 5-5.

Table 5-5: Typical zinc anode components

Element	Composition (maximum %)
Aluminium (Al)	up to 95.3
Zinc (Zn)	4.5 to 5.5
Iron (Fe)	0.09
Silicon (Si)	0.08 to 0.12
Copper (Cu)	0.0003
Other	0.02 max

Source: MCPS (2017)

The heavy metal input from the anodes is relatively minor when compared to the inputs from the steel. Table 5-5 shows that with the exception of aluminium and zinc, many of the other components are only present in trace quantities. Mercury (Hg), Cadmium (Cd), Lead (Pb), Chromium (Cr), Cu, Zn and Nickel (Ni) are potentially the most environmentally hazardous materials identified in North Sea pipelines of a similar construction (MPE, 1999). Above a threshold, these metals are toxic to marine organisms and can bioaccumulate. This threshold is dependent on variables in the environment including the rate of release (determining the concentration in the surrounding water), the temperature and salinity of the water, presence of other metals and the bioavailability of a metal (which depends strongly on its chemical speciation).

Metals are chemical elements which will not degrade further once discharged to seawater. As free cations, the natural states of metals in seawater have almost indefinite solubility and will quickly dilute to non-toxic concentrations. Metals may also complex with inorganic constituents of seawater such as sulfate. Corrosion and degradation depends on a multitude of variables and as such it is not possible to predict the rate of release of metals or other contaminants to the environment.

The toxicity of a given metal varies between marine organisms for several reasons, including their ability to take up, store, remove or detoxify these metals (Kennish, 1997). Concentrations of the metals are not expected to exceed acute toxicity levels at any time. However, chronic toxicity levels may be reached for short periods within the interstitial spaces of the sediments or in close proximity to the pipelines. At these levels, heavy metals can act as enzyme inhibitors, adversely affect cell membranes, and damage reproductive and nervous systems. Changes in feeding behavior, digestive efficiency and respiratory metabolism can also occur. Growth inhibition may also occur in crustaceans, molluscs, echinoderms, hydroids, protozoans and algae (Kennish, 1997). It is expected that any toxic levels will be short lived and localised with minimal potential to impact populations of marine species. The potential for uptake and concentration of metals would also be limited to the local fauna and due to the slow release of these chemicals not likely to result in a significant transfer of metals into the food chain.

A benthic species of concern in the area is *S. spinulosa.* Some practitioners consider *S. spinulosa* relatively insensitive to metal or chemical contaminants (Holt et al., 1998), although direct evidence is limited. Studies of the response of *S. spinulosa* to an outfall from a bromide extraction works containing free halogens (Hoare and Hiscock, 1974) suggest that it is generally tolerant of changes in water quality (UK Biodiversity Group, 1999). A further study by Walker and Rees (1980) recorded that down-tide of a sewage discharge in Dublin Bay; *S. spinulosa* was present in greater densities and diversities than elsewhere in the bay, indicating a level of tolerance for environmental change. *S. spinulosa* are also known to have life history strategies which enable them to exist in variable or unpredictable environments, responding to suitable conditions with a high rate of reproduction and rapid development (Krebs, 1985; MacArthur and Wilson, 1967).

Along buried pipeline corridors there may be accumulations of heavy metals in the sediments. These sediments are also likely to form bonds with these metals, making them less bioavailable to marine organisms (MPE, 1999). The slow release of the metals associated with the pipeline steel is expected to have a negligible impact on the local environment. It is anticipated that failure of the pipelines due to through-wall degradation would only begin to occur after many decades (i.e., 60 to 100 years) (HSE, 1997). The area that could be biologically impacted would likely be limited to a few metres on either side of the pipeline.

5.6.1.2 Plastic

The Victoria pipeline is coated with a plastic layer (3 Layer Polypropylene (3PLP)) and the umbilical with polyprolene (PP) (Verus Petroleum, 2018a). Polypropylene is considered non-toxic in the marine environment (DNV, 2006). However, as no micro-organisms have evolved to utilise the chemically resistant polymer chains as a carbon source, these plastics can be expected to persist in the environment for centuries (Oil and Gas UK, 2013). As biodegradability in the marine environment is also low, it can be assumed that the toxicity and subsequent environmental effect of leaving these plastics in place would not be significant (MPE, 1999). The most likely degradation mechanism would be via thermo-oxidative degradation, expected to be extremely limited due to thermal conditions pipeline and umbilical are exposed to and the lack of Ultra Violet (UV) exposure, assuming they remain buried, leading to the materials retaining integrity for several hundreds of years (Mardel, 2018).

5.7 Cumulative & Transboundary Impacts

Following completion of the Victoria decommissioning activities, the total maximum seabed impact is expected to be approximately 0.029 km^2 (items removed from the seabed 0.005 km^2 (Table 5-2) and overtrawlability survey 0.024 km^2), which represents 0.0008% of the North Norfolk Sandbanks and Saturn Reef SAC (JNCC, 2017c).

In addition to NEO's activities occurring in the North Norfolk Sandbanks and Saturn Reef SAC, proposed and approved activities submitted to BEIS by other operators indicate further activities are, and will be, undertaken in the SAC (Table 5-6).

Table 5-6: Other activities in the area with potential for cumulative effects

Location	Company	Type of activity	Temporary impacted area (km^2)	Permanently impacted area (km^2)
A-Fields well abandonment	Centrica	Decommissioning Programme	0.0029	0
Ann and Alison	Centrica	Decommissioning Programme	15.3924	0.0252
Annabel and Audrey	Centrica	Decommissioning Programme	11.6753	0.0810
Viking and LOGGS	Chrysaor	Decommissioning Programme	0.0144	0.6208
Leman BH	Shell	Decommissioning Programme	0.4058	0
Hornsea Project Three	Dong Energy	Windfarm development	10.38	-
TOTAL	-	-	37.8708	0.7270

The total temporary cumulative impact of NEO and other activities is estimates at 37.8998 km^2, which constitutes 1% of the North Norfolk Sandbank and Saturn Reef SAC affected, with majority of the temporary impact attributed to the overtrawlability surveys.

The Victoria decommissioning activities, in combination with the ongoing and previous stabilisation works, will increase the long-term seabed impact within the wider SAC area. However, decommissioning the majority of the Victoria subsea infrastructure in situ, with no introduction of additional material into the SAC, minimises the cumulative impact of these activities.

The proposed decommissioning activities are located, approximately, 45 km west of the UK/ Netherlands median line. Decommissioning activities are not anticipated to create any transboundary impacts.

5.8 Proposed Mitigation Measures

Mitigation measures to minimise seabed impacts within the Victoria decommissioning area are detailed within Table 5-7.

Table 5-7: Proposed mitigation measures for seabed impacts

Potential source of impact	Proposed mitigation measure
Subsea equipment cutting, excavation and lifting	Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment to minimise any impact on seabed sediment.
Placing jack-up spudcans	Spudcans will be completely removed from the seabed at the end of the decommissioning operations.
Debris trawlability survey	Due to the sensitive environmental setting, presence within the North Norfolk Sandbanks and Saturn Reef SAC, an alternative, non-invasive, method of debris clearance along the pipeline corridor and areas where decommissioning work has not directly taken place will be used.

5.9 Conclusions

The jack-up rig will be placed adjacent to the Victoria wellhead during decommissioning operations. Placement of the spudcans of the four-legged jack-up rig on the seabed will create some temporary, short-term disturbance of seabed sediments, over an estimated area of 0.00009 km^2. The spudcans will be removed from the seabed following decommissioning operations. Given the dynamic seabed conditions, recovery of the seabed and associated fauna is expected to be rapid (approximately a year).

The excavating, cutting and lifting of the Victoria subsea infrastructure will create a temporary, short-term disturbance of the seabed sediments, over an estimated area of 0.00448 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. Recovery of the seabed and associated fauna following the removal of the subsea installations is expected to be rapid (less than a year).

The overtrawlability survey has a potential of temporarily impacting an area of 0.024 km^2, as the worst-case scenario. However, due to the sensitive environmental setting NEO will endeavour to use alternative survey methods, which will be discussed and agreed with OPRED.

Overall, the Victoria decommissioning activities are expected to create a maximum seabed impact of 0.029 km^2, representing 0.0008% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC.

6 Discharges to Sea

This section discusses the potential planned discharges to sea resulting from the proposed decommissioning activities of Victoria subsea infrastructure. Unplanned discharges occurring during accidental events are not covered in this section but are discussed in Section 9.

6.1 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.

6.2 Approach

During the decommissioning of the Victoria subsea infrastructure and the associated vessel operations, the following subsurface activities or decommissioning strategies may lead to contaminated fluids and/ or solids entering the marine environment:

- Instantaneous discharge of contaminants during pipeline flushing, cutting and removal operations; and
- Long-term release of residual contaminants in subsea pipelines, through pipeline degradation over time.

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 NEO will put in place.

NEO do not foresee the opportunity for any contaminants to be discharged during general vessel activities. NEO will ensure that every effort is made to achieve an acceptable level of cleanliness of infrastructure prior to decommissioning activity commencing, reflecting the intent of current guidance from the Health and Safety Executive (HSE) and BEIS. These operations have therefore been assessed as low impact and are discounted from further assessment.

6.3 Sources of Potential Impacts

The following section provides an overview of the two main potential discharge streams (excluding any accidental releases; see Section 9), that may have an environmental impact. The pipeline will be flushed with seawater to remove the contents. The pipeline contains a mixture of hydrocarbon gas, condensate and water. NEO will use a vessel to vent the pipeline to sea at the Victoria valve manifold and allow the pipeline to free flood from Victoria. NEO plan to relocate the vessel to Viking BD skid and then flush the remaining contents to sea. The gas will be vented and the liquids discharged to sea. There are currently no plans to flush the umbilical prior to decommissioning.

There will also be a slow release of contaminants from the pipeline and umbilical decommissioned in situ as they degrade over time. The main source of the long-term contamination would be the degradation products of the steel pipeline and anodes. The impacts from degradation of the pipeline and umbilical are addressed in Section 5. As the pipeline and umbilical degrade, any residual content will be released to the environment, however this will not be an instantaneous release and will occur over many decades and in small quantities

This section will consider the potential for short- and long-term release from the decommissioning of the pipeline and umbilical in situ.

6.3.1 Potential Contaminants in Gas Pipeline

The pipeline PL2526 contains a mix of hydrocarbon gas, condensate and water (Section 2.4.1). One vessel will be used to vent the pipeline to the sea at the Victoria valve manifold, allowing it to free flood. The vessel will then be relocated to the BD skid and flush the remaining contents to sea. The pipelines will be flooded with seawater.

When the gas and condensate are initially released to the environment at the seabed they will rise through the water column from a pressure of approximately 2.1 barg at the seabed to atmospheric pressure at the surface. The gas phase released on flushing will expand as it rises from approximately 60 m^3 in the pipeline at 5 barg, to approximately 375 m^3 at sea level, where it will be rapidly dispersed by wind. The condensate phase released from the pipeline will rise through the water column and will gradually vaporise as the pressure reduces from 5 barg at the seabed to atmospheric pressure at the surface. No condensate will pool or remain undispersed on the surface of the sea (Verus Petroleum, 2018b).

This will result in a short-term contamination of water column. There is also potential for the long-term release of the residual pipeline contents to surrounding environment as the degradation of the pipeline progresses, however the residual volume is expected to be low.

Compounds in residual fluids lost to the marine environment undergo weathering, which tends to reduce their concentration in the receiving environment and decrease potential toxicity to marine organisms (Neff, 1987). Residual fluids will dilute readily dependent on the rate of introduction and local hydrographic conditions. Dilution rates of 30 to 100-fold occur within the first few tens of metres of the discharge point, and at distances 50 to 1,000 metres of this point, rates of 1,000 to 100,000 times are typical (OGP, 2005).

During the first hours after release, dilution is the predominant mechanism in concentration reduction. Similar entrained waste streams such as produced water present a 100-fold dilution factor within 50 m of the discharge point (Somerville et al., 1987). After it is discharged, contaminated fluids will be first diluted by the turbulence close to the discharge point, and then widely dispersed by marine currents. Due to the low volumes of contaminants discharged and the rapid dispersion in the environment, long-term or chronic effects are therefore unlikely.

6.3.2 Potential Contaminants in Umbilical

The umbilical PLU2527 will be decommissioned in situ. The fluids within the umbilical cores are comprised of a corrosion inhibitor, methanol mixture and hydraulic fluids (). The biodegradable, water-glycol subsea hydraulic control fluids, Aqualink 300E and 300F represent 1,562 litres and 781 litres, respectfully, of the total fluids within the umbilical. There are 1,002 litres of methanol (CH_3OH) with 0.005% (0.5 litres) of corrosion inhibitor (K15351). The remaining fluid is deionised water (1,002 litres) (Verus Petroleum, 2018b).

Upon disconnection of the line, an initial release of contents to sea is expected as hydrostatic equilibrium is reached with the surrounding water column, which will result in a short-term impact to the water column. Following this, the contents will be released into the sediments during the breakdown of the components of the umbilical. Umbilicals contain large quantities of polymers and Corrosion Resistant Alloys (CRA) and it is therefore not possible to predict when it will completely degrade. The impact will be low to the marine environment but long-term over a prolong period of time as degradation of the umbilical progresses.

The corrosion inhibitor (KI5351) is toxic to marine life, with a CEFAS rating of Gold. A small minority of the product has a low molecular weight (<700) and is not assumed to bioaccumulate. Further, the corrosion inhibitor is biodegradable and soluble in water. The small volume (500 ml total) will be released gradually and any impact would be highly localised.

The methanol and Aqualink are considered, under the OSPAR list of substances and preparations used and discharged offshore, to pose little or no risk to the environment (PLONOR).

Aqualink 300E and Aqualink 300F are Offshore Chemical Notification Scheme (OCNS) group rated “D” indicating that they have no bioaccumulative potential and negligible toxicity. The relatively benign nature of the fluids combined with the very gradual release should result in a minimal impact on the marine environment.

6.4 Impacts on Sensitive Receptors

The potential for short-term and long-term impacts of discharges to sea from the decommissioning of the Victoria subsea infrastructure 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).

6.4.1 Plankton

Some localised toxicity to planktonic organisms may result from the release of fluids contaminated with entrained hydrocarbons during and after the proposed decommissioning operations. The localised release of such fluids is likely to become rapidly diluted within the water column to levels below concentrations known to cause lethal or sub-lethal effects to the planktonic community (Lee and Neff, 2011; Neff, 2002).

Consequently, a short-term release of any remaining contaminated fluid does not present a risk to the planktonic community. The long-term impacts of released contaminants are negligible due to the dilution factor, the low concentrations released and the time frame involved.

6.4.2 Fish & Shellfish

As pelagic finfish are highly mobile, it is unlikely that there will be an impact on the finfish community (Gamble et al., 1987). There is a low probability of fish, shellfish or other epibenthic organisms in the water column and on seabed being impacted by residual fluid or solid contaminants due to the expected low concentrations of hydrocarbons or chemical contaminants in the seawater. There is the possibility that fish and shellfish may be exposed to chemical and/ or metal contaminants through their feeding on benthic organisms that have been exposed to low levels of contaminants. However, this food web exposure would be of a low concentration and localised and would only impact individual organisms with little or no impact to the species’ populations in the area.

6.4.3 Protected Habitats & Species

The Victoria subsea infrastructure is located within the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea cSAC.

Annex I habitats occurring within these SACs include sandbanks and biogenic reef habitats formed by the polychaete worm *S. spinulosa* (Section 3). As discussed in Section 5, the short or long-term release of contaminated fluids or solids is expected to have a negligible impact on either Annex I habitat due to the energetic hydrodynamic regime.

Annex II species sighted within the Victoria decommissioning area (Quadrant 49) include the harbour porpoise, which was sighted in high numbers in March and low numbers in February, April, May and August, while in the surrounding quadrants, were recorded in low to very high numbers throughout the year (Section 3.2.5). Low numbers of bottlenose dolphins were only sighted in the surrounding quadrants in November (Section 3.2.5). Harbour and grey seal density in Block 49/17 and surrounding blocks is very low (Section 3.2.5).

The short-term release of contaminated fluids is unlikely to have an effect on either of the Annex II species noted. The high mobility of these species suggests that no discernible impact on individuals or populations would be expected.

Long-term impacts on Annex I habitats are predicted to be negligible due to the extent of habitat, the dynamic water regime and the volumes and concentrations likely to be lost over time. Long-term impacts to Annex II species of concern to the area are equally unlikely to have any effect, due to the likely pathways of contamination and the mobile nature of the species.

6.5 Cumulative & Transboundary Impacts

The distances, both spatial and temporal, between operations and the dilution factors recorded for fluid contaminants will prevent cumulative short-term impacts.

The long-term cumulative effects have also been considered, to account for the degradation and eventual collapse of the pipelines decommissioned in situ. It is not thought that these will lead to a significant cumulative impact, as release rates will be over a long period (several decades to centuries), of small volumes or amounts, and potentially locked within the surrounding sediments if the pipelines remain buried over time.

Previous monitoring programmes in regions with high densities of offshore installations and significant volumes of entrained water discharges, have confirmed the presence of constituent compounds around the offshore installations, however, they have not identified any negative environmental effects (Bakke et.al, 2013). In the North Sea, surveys of contaminants in fish tissue have not revealed elevated levels of contaminants from entrained fluids (OSPAR, 2009). Similar results have been found for the Gulf of Mexico (OGP, 2005).

The Victoria subsea infrastructure are located, approximately, 45 km west of the UK/ Netherlands median line and since all identified impacts would be localised and within UK waters, no transboundary impacts are anticipated for either short term or long-term impacts.

6.6 Proposed Mitigation Measures

The key mitigation measures proposed for potential discharges identified within this section are presented in Table 6-1.

Table 6-1: Proposed mitigation measures for discharges to sea impacts

Potential source of impact	Proposed mitigation measures
Release of contaminants from pipeline and umbilical during decommissioning activities	Flushing pipeline with sea water prior to decommissioning activities
Release of contaminants from pipeline and umbilical over the long term	Pipelines will be flushed and flooded with seawater prior to decommissioning Following decommissioning, environmental monitoring surveys will be undertaken under an agreed schedule as per BEIS guidelines

6.7 Conclusions

Flushing and flooding of the pipelines will introduce chemical contaminants to the sediment and water column, but these are expected to be quickly dispersed given the active hydrodynamics in the region and sequestered in the sediment. Long-term degradation of the pipeline and umbilical will introduce residual chemicals to the sediment and water column over an extended period. The effect is not expected to be significant and is not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities.

7 Societal Impacts

This section describes the societal impacts associated with the proposed decommissioning activities of the Victoria Subsea Infrastructure. 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). Due to the location of the Victoria Field 87 km from the nearest coast, only potential offshore impacts were addressed.

7.1 Regulatory Context

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

7.2 Approach

During the Victoria subsea infrastructure CA (BMT Cordah, 2018b), stakeholder engagement activities (Table 1-3) and the risk assessment of this EIA (Section 4), the activities identified as having a potential societal impact were:

- An increase in vessel collision risk between the decommissioning vessels and other users of the sea; and
- Post-decommissioning damage to or loss of fishing gear as a result of subsea infrastructure (pipelines) decommissioned in situ, posing potential snagging risks.

7.3 Sources of Potential Impacts

Some aspects of the proposed decommissioning activities have the potential to lead to societal impact, interfere with fishing activities and other users of the sea.

- Increased vessel activity; and
- The presence of pipelines decommissioned in situ.

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

7.3.1 Interference with Other Sea Users

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 Victoria Field, being ultimately dependent upon the location of the decommissioning port(s) and associated transiting routes.

A maximum of four vessels may be present at any one time within the Victoria decommissioning area to undertake flushing operations and structural removal. The type of vessels present may include:

- Jack-up rig
- Construction Support Vessel (CSV)
- DS
- PSV
- Guard vessel; and
- Survey vessel

7.3.2 Damage to or Loss of Gear

Once decommissioning activities have ceased, there is the minimal potential for fishing gear to snag on pipeline and umbilical infrastructure decommissioned in situ. Examples include any pipeline sections that could potentially become exposed over time. This may result in the loss of catch/ revenue for fisheries with the potential, in extreme cases, for the loss of the fishing vessel itself.

There is a potential for a number of depressions and berms to be left on the seabed following decommissioning. These would arise from:

- Deploying the jack-up rig spudcans; and

- Excavation at the pipeline ends and piles to enable these to be severed from the seabed.

Vessels operating demersal gear have the highest risk associated with fastening gear on obstructions due to the nature of their activity. Whilst there is also potential for pelagic and fixed gear to snag on subsea obstructions, the associated risks are considered to be slightly lower than demersal gear due to the nature of the activities and the design of the gear itself.

7.3.3 Pipeline & Umbilical Burial Status

The pipeline burial analysis of the Victoria pipeline (PL2526) and the associated umbilical (PLU2527) has shown that for the majority of surveyed length, both remained buried between 2008 and 2013 (BMT Cordah, 2018a; Canyon, 2008; Bridge Energy, 2013). The analysis of the suite of ROV imagery data for the 2013 survey indicates the majority of the pipeline remained buried below 0.6 m over the majority of the 3 km surveyed length. The images allowed the observation of the status of the protective material covering pipeline and umbilical at Victoria valve skid end and, as far as the data allows, these appear to be in good order. For the rest of the survey the video data covered only the pipeline. Particular emphasis was placed on examining the video footage at the location of the non-reportable span presented in the 2012 data. The 2013 data shows the absence of this span, indicating the possibility of a data error in 2012. These could have resulted from the ROV veering off track during the survey often a result of navigational glitches or strong tidal currents.

This evidence would suggest that the placement of protective material, the pipeline and umbilical parallel orientation in relation to the migrating bedforms and original pipeline and umbilical burial depth as trenched in 2008 was sufficient to ensure the assets have remained buried over the five-year period. Given that sand waves migrate over periods less than five years in addition to the evidence from 2013 multi-beam survey, it is reasonable to assume that the Victoria pipeline and umbilical will remain buried within the migration rates of these features (BMT Cordah, 2018a; Cooper et al., 2008; Kenyon and Cooper, 2005).

A seabed survey of the pipeline and umbilical will be conducted prior to the start of any decommissioning activities. If depth of burial is less than 0.6 m, remedial activities will be undertaken.

7.4 Impacts on Sensitive Receptors

The long-term physical presence of pipeline and umbilical 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 flushing and removal operations.

7.4.1 Impacts on Fishing Activities

As the PL2526 pipeline and PLU2527 umbilical are to be decommissioned in situ the only increase in vessel traffic will be associated with surveys along the pipeline and vessel movements associated with the removal of the spools and other infrastructure. With respect to fishing activities, further potential impacts include the limited loss of access to fishing grounds during decommissioning activities and the impedance to fishing gears by subsea structures, including any pipelines decommissioned in situ. NEO is also intending to decommission pipeline crossing, and associated mattresses and grout bags, in situ, which may potentially interfere with fishing activity. It is NEO's intention to evaluate the crossing for its snagging risk to fishing vessels. If it is not safe the remediation will be undertaken, based on the discussion with OPRED.

Beam trawl was the main method of fishing in ICES rectangle 35F2 in 2016 (Section 3.4). This method has the potential to interact with subsea pipelines and mattresses. The weight and width of fishing gear and the nature of the benthic substrate will ultimately determine the level of impact. However, the pipeline and umbilical will be decommissioned in a state that leaves adequate surface coverage over the top of the infrastructure, the potential impact on fishing activities will be minimal.

The footprint resulting from decommissioning the pipeline and umbilical in situ in the Victoria area is estimated to be 0.001 km^2 (Table 7-1), representing 0.00003% of the North Norfolk Sandbanks and Saturn Reef SAC area (3,603 km^2; JNCC, 2017c).

The impact of the remaining infrastructure is expected to be negligible, as the pipeline and umbilical are trenched and buried, and already present.

Table 7-1: Pipeline and umbilical decommissioned *in situ*

Item decommissioned in situ	Dimensions of remaining pipeline	Seabed impact (km^2)	Percentage of SAC's seabed impacted
Pipeline PL2526	3.689 km long x 0.15 m diameter	0.000553	0.000015
Umbilical PLU2527	3.68 km long x 0.108 m diameter	0.000397	0.000011
TOTAL		0.000950	0.000026

Source: Verus Petroleum (2018a)

Commercial fisheries data for 2016 show that the majority of fishing activity in the region are demersal and shellfish (Section 3.4). The relative fisheries value and landings for demersal gear in 2016 was relatively low (Table 3-5), indicating low fishing activity in the area.

The predominant fishing method in the decommissioning area is beam trawl (Section 3.4). Traditional open beam gear comprises a cylindrical steel beam up to 12.0 m in length from which a net and associated steel 'tickler' chains are attached. The total weight of this gear can vary from five to eight tonnes. The fishing vessels tow this heavy gear at speeds of up to seven knots.

The relatively fast speed and use of heavy gear could potentially result in an interaction, which could result in damage to both the fishing gear and the decommissioned pipelines. However, due to the vessel parameters and the majority of the pipeline and umbilical having relatively small diameters (a maximum of 6 inch), the potential for any strike between fishing gear and pipeline resulting in a vessel coming fast and in turn sinking, is low. Additionally, the pipelines and umbilical decommissioned in situ will be buried presenting a clear seabed, further reducing the potential for interaction with fishing gear.

The decommissioning activities may also result in a number of seabed depressions and scars resulting from the removal of the Victoria subsea infrastructure, excavation of pipeline ends and piles, and placing spudcans.

Based on the dynamic nature of the environment in the vicinity, it is anticipated that these depressions will backfill naturally over time. The natural recovery of anchor scars and similar depressions was observed at between 1 and 5 years, depending on the environmental conditions present (Loe, 2010; Hill et al., 2011; Thompson et al., 2011).

7.4.2 Impacts on Commercial Shipping

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.

7.4.3 Vessel Collision Risk

The shipping density within the block of interest is stated to be very low (Section 3). Vessel activity within the Victoria decommissioning area will be associated with:

- Decommissioning activities;
- Site specific surveys conducted before decommissioning operations commence;
- Post-decommissioning survey work; and
- Debris survey and clearance activities.

These activities will be short in duration and accompanied by the required permitting and notifications to mariners, therefore mitigating potential impact to a negligible level of significance.

7.5 Cumulative & Transboundary Impacts

Given the location of the Victoria Field, approximately, 45 km to the west of the UK/Netherlands median line, there are no transboundary impacts anticipated.

There are a number of oil and gas infrastructures in the North Sea which could potentially undergo decommissioning at the same time as the Victoria subsea infrastructure. In addition, there is also potential for construction activities to occur in the area as a result of wind farm export cable development. Given the predominately localised and limited nature of the activities associated with the Victoria decommissioning programme, it is unlikely that there will be any cumulative societal impacts.

7.6 Proposed Mitigation Measures

Proposed mitigation measures to minimise societal impacts are detailed in Table 7-2.

Table 7-2: Proposed mitigation measures for societal impacts

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. Notice will be taken of other Notices to Mariners relevant to the area in the vicinity of the Victoria decommissioning activities. 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 Victoria 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	On-going consultation with fisheries representatives. Post-decommissioning seabed clearance. Clear seabed survey assessment during decommissioning and periodically thereafter. On-going post decommissioning monitoring of the infrastructure decommissioned in situ, the frequency and nature of which will be agreed with BEIS. Materials decommissioned in situ will be mapped and the UK Hydrographical Office (UKHO) and Kingfisher informed.
Long-term environmental impacts of the physical presence of the pipeline and umbilical decommissioned in situ.	Post-decommissioning survey to accurately map the location of subsea structures decommissioned in situ. Potential post-decommissioning monitoring of routes of the buried pipeline routes will be discussed as part of any future monitoring programme agreed with BEIS. Potential remedial intervention in the event issues arise with the pipeline exposure or interaction with other users.

7.7 Conclusions

There will be a minor impact to fishing activities during the decommissioning operations in the Victoria area and transient loss of access for vessels during the decommissioning operations. This impact will be reduced by minimising the number of vessels travelling to, or standing by, the Victoria subsea infrastructure once it has been decommissioned and taking notice of any relevant Notices to Mariners. Potential damage or loss of demersal fishing gear will be minimised through the burial of the pipeline, umbilical and cut ends.

8 Underwater Noise

Sound is important to many marine organisms, with marine mammals, fish and certain species of invertebrates having a range of complex mechanisms for both the emission and detection of sound (Richardson et al., 1995). Underwater noise may cause animals to avoid activities, potentially interrupting feeding, mating, socialising, resting and migration. Noise disturbance therefore may have consequential impacts upon the body condition and the reproductive success of individuals or populations (Southall et al., 2007; Richardson et al., 1995). Indirect impacts may also result should the noise disturb prey species, making feeding more difficult (Southall et al., 2007; Richardson et al., 1995).

During the proposed decommissioning of the Victoria subsea infrastructure and flushing operations, noise may be generated by a number of sources including:

- Well P&A with a jack-up drilling rig
- DSV
- PSV
- Survey vessel
- CSV
- Heavy Lift Vessel (HLV)
- Guard vessel
- Helicopters
- Pipeline cutting; and
- Lifting and removing the pipeline and umbilical sections

These sources will emit low frequency noise both into the air and water column. The introduction of additional anthropogenic sounds into the environment has the potential to affect the behaviour of and, in extreme cases, even injure local wildlife.

This section will consider the noise and potential impact generated during the Victoria decommissioning activities.

8.1 Regulatory Context

The control of underwater noise is driven by Regulations 41(1) (a) and (b) of the Conservation (Natural Habitats & c.) Regulations 1994 (as amended), and 39(1) (a) and (b) in the Offshore Marine Conservation (Natural Habitats & c.) Regulations 2007 (amended 2009 and 2010), which include a specific reference to the disturbance, injury or death of European Protected Species (EPS).

According to these regulations, it is an offence to:

- Deliberately capture, injure or kill any wild animal of an EPS; or
- Deliberately 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;
- 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 species of cetaceans (whales, dolphins and porpoises) (JNCC, 2017f). As underwater noise has the potential to cause injury and disturbance to cetaceans, an assessment of underwater noise generated by the activities associated with a proposed development is required in line with guidance provided by the JNCC (2017g).

8.2 Approach

The impact of underwater noise on any sensitive receptors is assessed here using a modelling approach, which includes the identification of potential noise sources, an evaluation of their levels and frequencies, an introduction to relevant underwater noise propagation pathways and the appropriate assessment model,

followed by an impact assessment. The assessment results are then compared against relevant values from the literature, addressing both behavioural impacts to and injury of the target species. Any identified potential issues are then evaluated with respect to transboundary and cumulative impacts.

8.3 Sources of Potential Impacts

The quantification of noise impacts from Victoria subsea infrastructure decommissioning activities has been evaluated based on relevant scientific literature. In addition, potential noise impacts resulting from associated vessels activities were further investigated using the Marsh-Schulkin propagation model (Schulkin and Mercer, 1985). The Marsh-Schulkin model applies to acoustic transmission in relatively shallow water (up to, approximately, 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 is likely to be lower than predicted within this assessment.

8.3.1 Assumptions

For all vessel operations, it is assumed that a maximum of four vessels will be on site at any given time. Sensitivity studies were undertaken to determine the worst case in relation to the number of vessels and water depth present within the decommissioning area.

8.3.2 Victoria Decommissioning Operations

All of the potential noise sources associated with the Victoria decommissioning operations are classed as continuous sounds and, as such, do not fall into the target MSFD descriptor for loud, low-frequency impulsive sounds. The vessel noise, dominant sound source, is classed as a non-pulse noise source. Of note here is that the use of explosives is not currently anticipated by NEO during Victoria subsea infrastructure decommissioning activities.

8.3.2.1 Vessels

Broadband source levels for vessels rarely exceed 190 dB re 1 µPa m and are typically much lower (Hannay and MacGillivray, 2005; 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 a vessel's operating status and can 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.

The modelling undertaken used data from Hallett (2004) to represent four vessels in the chosen scenario. Hallett (2004) investigated underwater radiated noise measurements of ten merchant ships (lengths 89 to 320 m, average 194 m) during port entry or exit. Whilst not directly representative of the vessels movements anticipated for Victoria subsea infrastructure decommissioning operations, it is considered that the use of Hallett (2004) data provides a more conservative measure of vessel noise than many of the published examples for specific construction and support vessels. Hence, the resultant noise spectrum has been used to represent each vessel modelled with the overall cumulative effect being calculated.

8.3.2.2 Pipeline cutting

Pipelines would be exposed using jetting methods and would be removed by cutting with an underwater pipe cutter and lifting the cut pipeline sections onto a vessel for transportation to shore.

Underwater noise from pipeline cutting is expected to be temporary and short-term. No studies are currently available in the literature referring to noise assessments from pipeline cutting. However, it may be expected that target species could be temporarily disturbed.

8.3.2.3 Helicopters

Helicopter activities related to Victoria subsea infrastructure decommissioning will occur throughout operations. Helicopter noise originates from both the sea surface disturbance by the downwash from the rotor blades and the transmission of engine and blade noise directly into the sea. The downwash noise is very similar to wind noise in its frequency characteristics and is greatest in the 2 to 20 kHz region. Additional strong tonals in the 10 to 100 kHz range are associated with rotors and turbine operation, respectively (Harland et al., 2005).

When sound travels from air to water, the energy is largely reflected back from the water surface and only a small fraction of the sound produced by the helicopter is actually transmitted into the sea. Although helicopter sound is fairly broadband (0 to 20 kHz), the lower frequency sound, up to 200 Hz, is much more pronounced (Berrow et al., 2002). The dominant tones in the noise spectra from helicopters are generally below 500 Hz (Richardson et al., 1995). The angle at which sound from the aircraft intersects the water's

surface is also important. At angles greater than 13° from the vertical, much of the incident sound is reflected and does not penetrate into the water (Richardson et al., 1995).

Levels and durations of sounds received underwater from a passing aircraft depend on its altitude and aspect, receiver depth and water depth. In general, the peak received sound level in the water from the aircraft directly overhead decreases with increasing aircraft altitude (Richardson et al., 1995).

8.4 Impacts on Sensitive Receptors

Underwater noise can affect the behaviour of or may cause injury to several different marine taxa, in particular fish and marine mammals such as pinnipeds and cetaceans.

8.4.1 Fish & Shellfish

Many fish species use sound for prey location, predator avoidance 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 majority of fish species detect sounds from below 50 Hz and within the range 500 to 1500 Hz. A small number of species can detect sounds to over 3 kHz, with very few species able to detect sounds over 100 kHz. Fish with the narrower bandwidth of hearing are often referred to as “hearing generalists” or hearing “non-specialists” whilst fish with the broader range are often called “hearing specialists”. The difference between hearing generalists and specialists is that the latter usually have specialised anatomical structures that enhance hearing sensitivity and bandwidth (Popper and Hastings, 2009).

Hearing generalists include salmonids, cichlids, tunas and numerous species. Hearing specialists include all the Otophysi and Clupeiformes, and some representatives in a wide range of other fish groups including a few holocentrids and sciaenids. The fish known to have the widest hearing frequency bandwidth are limited to the members of the clupeiform genus *Alosa* (Popper and Hastings, 2009).

The fish species found in the locality of the Victoria subsea infrastructure are mainly hearing generalists, with the exception of herring and sprat, which are considered as specialists.

The Victoria decommissioning area (ICES Rectangle 35F2) is located within spawning grounds for mackerel, cod, plaice, lemon sole, sole, sandeel, sprat, *Nephrops* and whiting. The Victoria decommissioning area also lies within the nursery grounds throughout the year for cod, herring, lemon sole, horse mackerel, mackerel, plaice, sole, sandeel, *Nephrops*, sprat, tope shark and whiting.

Fish exhibit avoidance reactions to vessels and it is likely that radiated underwater noise is the cue. For example, noise from research vessels has the potential to bias fish abundance surveys by causing fish to move away (De Robertis and Handegard, 2013; Mitson and Knudsen, 2003). Reactions include diving, horizontal movement and changes in tilt angle (De Robertis and Handegard, 2013).

A comprehensive review by Popper and Hastings (2009) on the effects of anthropogenic sound on fish concluded that there are substantial gaps in the knowledge that need to be filled before meaningful noise exposure criteria can be developed. De Robertis and Handegard (2013) mentioned that further research is needed, to identify the stimuli fish perceive from approaching vessels and to what extent fish perceiving these stimuli will react, before further recommendations to reduce vessel-avoidance reactions can be made.

8.4.2 Pinnipeds

Pinnipeds (seals) produce a diversity of sounds within a bandwidth 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. The grey seal and the harbour, or common seal, are both resident in UK waters and occur regularly over large parts of the North Sea (SCOS, 2017). Seals have not been reported in the block or surrounding blocks of the Victoria area.

8.4.3 Cetaceans

Cetaceans use sound for navigation, communication and prey detection. Anthropogenic underwater noise has the potential to impact on marine mammals (JNCC, 2017f; Southall et al., 2007; Richardson et al., 1995) including cetaceans.

The main cetacean species occurring in the Victoria area (Quadrant 49 and surrounding quadrants) are minke whale, (sightings in July and August), bottlenose dolphin (sightings in November), common dolphin

(sightings in February), long-finned pilot whale and white-sided dolphin (sightings for both in August). Species sighted throughout the year in the Victoria area are white-beaked dolphin and harbour porpoise.

There are major differences in the hearing capabilities of the different marine mammal species and, consequently, vulnerability to impact from underwater noise differs between species. Southall et al. (2007) established a classification based upon the hearing types of different marine mammal species (Table 8-1).

Table 8-1: Cetacean functional hearing groups

Frequency range	Estimated auditory bandwidth	Species sighted in Victoria area for the planned period of activities
Low-frequency	7 Hz – 22 kHz	Minke whale
Mid-frequency	150 Hz – 160 kHz	White-beaked dolphin, white-sided dolphin, bottlenose dolphin, common dolphin, long-finned pilot whale
High-frequency	200 Hz – 180 kHz	Harbour porpoise

8.5 Prediction of Injury & Behavioural Zones

8.5.1 Assessment using Southall *et al*. (2007) thresholds

In accordance with JNCC guidelines, the Marsh-Schulkin model (Schulkin and Mercer, 1985) was used to predict the distance from the activities beyond which the sound level would be too low for injury under the Southall criteria (Southall *et al*., 2007). In addition, the Nedwell $dB_{ht\ (species)}$ was then applied to determine both injury and avoidance zones for specific species. To compare the Southall criteria to predicted vessel operation noise levels, the non-pulse injury threshold was applied. The threshold for injury to cetaceans of 230 dB re 1 µPa m is higher than the model output Sound Pressure Level (SPL) of 195 dB re 1 µPa m. Therefore, the threshold for cetacean injury is not predicted to be exceeded for any of the decommissioning operations. Southall *et al*., (2007) does not provide non-pulse threshold recommendations for disturbance and therefore this method cannot be applied to determine disturbance zones.

According to Nedwell et al. (2007), the sound propagation model results (Table 8-2) indicate that the noise threshold for a likely injury reaction (130 $dB_{ht\ (species)}$) is unlikely to occur for any of the cetacean species within the vicinity of the vessel operations.

Table 8-2: Predicted frequencies causing greatest effect and radii within which likely avoidance and injury may occur for each species for the noise generated by the Victoria decommissioning operations.

Species[1]	Hearing threshold in range (dB)	Source level max (dB)[2]	Source level ($dB_{ht\ (species)}$)[2]	Frequencies causing greatest effect (kHz)[2]	Maximum radii of injury zone (m)[2]	Maximum radii of likely avoidance zone (m)[2]
Harbour porpoise	52	178	126	10	N/A	95
Bottlenose dolphin	51	176	125	14	N/A	106
White-sided dolphin[1]	66	181	115	8	N/A	29
White-beaked dolphin	69	175	106	16-20	N/A	14
Minke whale	90	197	108	0.1	N/A	16
Long-finned pilot whale	90	197	108	0.1	N/A	16

[1] No audiograms are available for common dolphin. The assessment for the bottlenose dolphin is based on a composite audiogram obtained from three audiograms sourced from Nedwell et al., 2004. Cetacean species presence data is given in Section 3. [2] Propagation model outputs.

The size of the avoidance zones will vary by species and range from 14 m (white-beaked dolphin) to 106 m (bottlenose dolphin) (Table 8-2). The disturbance radius area is calculated based on the distance it takes for the noise level to decrease to levels below the avoidance threshold. Modelling results predicted that the noise threshold for an avoidance reaction may be exceeded for bottlenose dolphin (106 m), harbour porpoise (95 m), white-sided dolphin (29 m), common seal (26 m), minke whale and long-finned pilot whale (16 m) and white-beaked dolphin (14 m).

8.5.2 Assessment using National Marine Fisheries Standards (2016 and 2018)

In September 2016, the National Marine Fisheries Service (NMFS), part of the National Oceanic and Atmospheric Administration (NOAA), published a document 'Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts' (NMFS, 2016) which includes an amended set of injury thresholds and an amended set of frequency 'weightings' to compensate for the different sensitivities of groups of mammals (referred to as NOAA Guidelines hereafter). This has since been widely adopted as preferable to the use of the Southall *et al*. (2007) thresholds for injury and it is noted that the document includes work by many of the same team contributing to the Southall *et al*. paper. The NOAA guidelines do not amend the thresholds or approach to the assessment of disturbance, only injury, using the metrics of peak sound pressure level (SPL) and cumulative sound exposure level (SELcum). These were supplemented in 2018 by an update ('Version 2.0' NMFS, 2018), which does not change the thresholds but which gives further interpretation on their use.

The underwater noise propagation has been re-modelled to take account of the NOAA thresholds for injury relating to peak levels, and for the weighting functions for LF, MF and HF cetaceans, and PW pinnipeds. This has been done by altering the source level frequency/amplitude profile and using the same noise propagation assumptions, since the received level equals the source level minus the transmission loss, and the transmission loss (calculated by third-octave frequency) has not altered.

This has been used to predict cumulative sound exposure levels over 24 hours for animals starting near the source and moving away. This is a theoretical assumption which does not necessarily reflect complex animal behaviour or the continuous nature of the noise exposure, but one which is repeatable and clear using an assumption that the animal begins at 10 m from the source and moves away at a swim speed of 2.5 m/s, which is within the lower range of swim speeds for such animals. Table 8-3 summarises the results and shows that no animals accumulate a dose (SEL_{cum}) that exceeds the non-impulsive injury thresholds put forward by NOAA in their 2016 and 2018 guidelines. As an even more extreme example, for an animal that approached the source from, a distance, passed within 10m and continued travelling away, the noise exposure would be doubled and would therefore the SEL_{cum} would increase by 3 dB, and would still be well below the injury thresholds given by NOAA. It is therefore concluded that injury is not plausible.

Table 8-3: Predicted frequencies causing greatest effect and radii within which likely injury may occur for each species relating to NOAA 2016 and 2018 acoustic thresholds.

NOAA species	Injury threshold (dB re 1 µPa)	Source level ($dB_{ht(species)}$ re 1 µPa)	Frequencies causing greatest effect (kHz)	SEL_{cum}* (dB re 1 µPa)	Maximum radius of injury zone (m)
Low-frequency (LF) cetaceans	199	182.2	0.1	179.6	0
Mid-frequency (MF) cetaceans	198	157.2	8	155.3	0
High-frequency (HF) cetaceans	173	152.8	8	150.8	0
Phocid pinnipeds (PW)	201	171.9	2.5	170.2	0

* For animal starting at 10 m from source and swimming away at 2.5 m/s

8.6 Transboundary & Cumulative Impacts

The Victoria decommissioning area is located approximately 45 km west of the UK/ Netherlands median line. At this distance noise levels from vessels, the greatest source of sound associated with the decommissioning of the Victoria subsea infrastructure, would attenuate to a level lower than that likely to cause injury or temporary displacement to any cetacean species. Therefore, there will not be a transboundary impact from the noise generated by the proposed decommissioning operations at the Victoria area.

Within 15 km of the pipeline there are eight platforms (all Chrysaor-operated). Within 1000 m of the PL2526 pipeline there are 7 wells, one skid and 22 pipelines.

Given the location of the proposed works, and the limited impact of Victoria noise related decommissioning activities, no cumulative impacts (resulting from cumulative sound sources) are anticipated with other oil and gas installations or fields.

The Victoria subsea infrastructure is located near areas of lease by the Crown Estate for offshore activity relating to two aggregate production areas (21 km NW and 19 km N) and a wind export cable in planning 40 km NE (Section 3.6).

Source levels at frequencies below 500 Hz from dredger vessels are generally in line with those expected for a cargo ship travelling at modest speed (MALSF, 2011). It is worth mentioning that the elevated broadband noise is dependent on the aggregate type being extracted (gravel generating higher noise levels than sand) (MALSF, 2011). In addition, due to the limited impact of vessel noise highlighted by the noise modelling assessment, no cumulative impacts from aggregate extraction activity would be expected.

8.7 Proposed Mitigation Measures

Appropriate mitigation measures, in accordance with the relevant JNCC guidelines (2017g), should be implemented during the proposed decommissioning operations (Table 8-4). Noise generated from vessel activities are generally not considered by JNCC (2017g) to pose a high risk of injury. The noise impact assessment undertaken supports this view, showing that it is unlikely there would be significant impact on any marine species. Consequently, it is considered unlikely that mitigation measures will be required beyond those listed in Table 8-4.

Table 8-4: Proposed mitigation measures for underwater noise impacts

Potential source of impact	Proposed mitigation measures
Underwater noise from decommissioning activities	Machinery and equipment will be in good working order and well-maintained

8.8 Conclusions

Sound levels associated with the decommissioning of the Victoria subsea infrastructure would attenuate to ambient levels within a few kilometres of the sound source. As such, it is unlikely that sound produced by the decommissioning activities would have an 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. Records indicate previous sightings of up to seven cetacean species in the vicinity of Victoria area across the year. The listed species are all subject to regulatory protection from injury and disturbance. A worst-case scenario for the modelling of underwater vessel noise has been undertaken for the decommissioning of Victoria subsea infrastructure considering one point source location and four vessels and is applicable for the Victoria decommissioning operations. This represents the maximum vessel number that may be at Victoria at any one time. The subsea noise levels generated by surface vessels used during the decommissioning operations are unlikely to result in physiological damage to marine mammals. Depending on ambient noise levels, sensitive marine mammals may be locally displaced by vessel noise in the immediate vicinity or by any other continuous noise source during the offshore decommissioning activities at the Victoria area. The individual and cumulative impacts from decommissioning activities at Victoria are not considered significant.

9 Accidental Events

This section evaluates the potential impacts of accidental events and the proposed mitigation measures NEO will implement to reduce the probability of occurrence and ensure that the impact to the environment is reduced as low as reasonably practicable.

With regard to offshore decommissioning operations, two types of accidental events present the most likely worst-case impacts to the environment:

- Hydrocarbon release
- Chemical spill

9.1 Regulatory Context

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

9.2 Approach

This sub-section examines the potential impacts of an accidental oil release occurring during the proposed decommissioning activities.

9.2.1 Sources of Potential Impacts

All offshore activities carry the potential risk of an oil spill to the marine environment. During the period 1975–2005, a total of 16,930 tonnes of oil were discharged from 5,225 individual spill events in the UKCS (UKOOA, 2006). Analysis of spill data between 1975 and 2005 identified that:

- 46% of spill records were related to crude oil;
- 18% of spill records were related to diesel; and
- 36% of spill records were related to condensates, hydraulic oils, oily waters and other materials.

In 2012, 248 oil spills were reported to DECC (now BEIS) on the UKCS, of which 8% were greater than 455 l (ACOPS, 2014).

The potential sources of hydrocarbon spillages from the Victoria subsea infrastructure have been identified through knowledge and experience developed from NEO oil and gas operations in the North Sea. The oil spill modelling carried out for Victoria (Victoria well and associated pipeline oil pollution emergency plan (OPEP)) indicates that the worst-case spill scenario would arise as a result of a diesel spill from a vessel. The presence of a vessel on site is periodic. Because the identity of such vessel(s) is not currently known, the diesel modelling conducted was based on estimates for a typical vessel's diesel inventory. The likelihood of a diesel spill occurring from operations at the Victoria decommissioning area is very low.

Despite the small probability of a vessel collision occurring and considering that the subsea infrastructure are not expected to contain hydrocarbon fluids, the possibility of hydrocarbon release from the Victoria subsea well and the impacts on sensitive receptors have been investigated in detail in the following sections.

9.2.1.1 Hydrocarbon properties

Hydrocarbons used in the Victoria Field include diesel and aviation fuel. Diesel and aviation fuel have very high levels of volatile components, evaporating quickly on release. The low asphaltene content in these fuels prevent emulsification, reducing their persistence in the marine environment.

9.2.2 Impact assessment and oil spill modelling

An accidental hydrocarbon release can result in a complex and dynamic pattern of pollution distribution and impacts in the marine environment. As there are a variety of natural and anthropogenic factors that can influence an oil spill, each one is unique. The extent of an oil spills environmental impact depends on variables including:

- Location and time of the spill;
- Spill volume;
- Hydrocarbon properties;
- Prevailing weather/ metocean conditions;
- Environmental sensitivities; and

- Efficacy of the contingency plans.

9.2.2.1 Overview of the modelling undertaken

Oil spill modelling has previously been undertaken for the Victoria area and is included within the Victoria subsea well OPEP (Verus Petroleum, 2014). This document has been approved by the regulator. All spill scenarios undertaken for the Victoria area were modelled using the Oil Spill Contingency and Response (OSCAR) model Version 6.5 (Table 9-1).

Table 9-1. Hydrocarbon properties

Oil	API (°)	Specific Gravity	Pour point (°C)	Asphaltene content (% mass)	Wax content (% mass)
Marine Diesel	36.4	0.843	-36	0	-

Three diesel spill trajectory modelling scenarios were undertaken from the Victoria well location (53˚27'44.350"N; 2˚17'4.285"E) using a release date of 01 January and average annual air and sea surface temperatures of 10.1 °C and 10.5 °C respectively (Table 9-2).

The results suggest that diesel hydrocarbons would not beach or cross the median line (on sea surface) before the end of the simulation (after 10 days) (Table 9-3).

Table 9-2. Hydrocarbon spill trajectory modelling scenarios

Scenario	Quantity lost (m^3)	Release duration (h (days))	Rate (m^3 h^{-1})	Model duration (days)*	Wind direction (°)
Towards UK coastline					
T1a: Diesel spill from vessels	667	1(0)	667	10	40
Towards UK/Netherlands median line					
T1b: Diesel spill from vessels	667	1(0)	667	10	270

*Time until amount of oil at sea became insignificant (< 5% of oil mass remaining at surface)

Table 9-3. Results from spill trajectory modelling

Scenario	Time until oil on surface crosses UK/ Netherlands median line (hours)		Time until surface oil is insignificant* (hours)		Impact to shore	
	Wind to UK	Wind to Median	Wind to UK	Wind to Median	Wind to UK	Wind to Median
T1: Diesel Spill	N/A	N/A	8	9	N/A	N/A

9.3 Impacts on Sensitive Receptors

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

9.3.1 Biological Receptors

Although there is only a small likelihood of a hydrocarbon spill from Victoria, there is a potential risk to organisms in the immediate marine environment if a spill were to occur (Table 9-4). As the majority of 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 more significant impacts.

Table 9-4. Summary of potential impacts to main biological receptors in the Victoria decommissioning area

Biological receptor	Impacts to biological receptors at risk in the Victoria area
Plankton	Localised effects to plankton community due to toxicity. Impacts on communities are unlikely due to natural variability, high turnover and seasonal fluctuation.
Benthos	The impact from diesel to benthic species or 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 release of diesel is unlikely to impact benthic communities and therefore the risk is considered minimal.
Fish, spawning and nursery grounds	Nine species of fish and shellfish spawn in the decommissioning area. The plaice spawning areas are considered to be a part of important spawning areas for this species, with a relative high intensity spawning recorded (Ellis et al., 2010; Coull, et al., 1998). The Victoria infrastructure also coincides with nursery grounds for 12 species of fish and shellfish (Aires et al., 2014; Ellis et al., 2010; Coull, et al., 1998). These species are present throughout the year. Adult fish are expected to avoid the affected area, but if affected, hydrocarbons 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. Demersal species may be influenced by habitat pollution.
Seabirds	The seabird sensitivity to surface pollution across the decommissioning area (Block 49/17) varies from low (August, September and October) to very high (March, June and July) and extremely high (February and December), with no data available for January, April, May and November (Webb et al., 2016).
Marine mammals	The main cetacean species occurring in the decommissioning area are white-beaked dolphin and harbour porpoise, with sightings occurring throughout the year. Further species observed in the surrounding areas include white-sided dolphin, minke whale, long-finned pilot whale, bottlenose dolphin and common dolphin (Reid et al., 2003; UKDMAP, 1998).
Offshore protected habitats	The decommissioning area is located within two SACs, one designated for their sandbanks, which are slightly covered by seawater all the time, and for their *Sabellaria spinulosa* reef habitats, and the other for harbour porpoise.
Inshore protected habitats and species	Based on oil spill modelling, coastal habitats will not be affected by a potential oil spill from the Victoria area.

9.3.2 Shoreline Impacts

Spill modelling undertaken for the NEO subsea well OPEP (Verus Petroleum, 2014), predict that diesel spills would not reach the UK and Netherlands coastlines (Table 9-3).

9.3.3 Socioeconomic Receptors

Socioeconomic receptors may be impacted by a potential spill from the proposed decommissioning activities (Table 9-5).

Table 9-5. Summary of main socioeconomic receptors

Socioeconomic receptor	Impacts to socioeconomic receptors at risk in the Victoria area
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 are limited to the period that oil remains on the surface 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. There is no UKCS evidence of any long-term effects of oil spills on offshore fisheries. The UK landings within the decommissioning area are relatively low, with the exception of the shellfish species in the coastal/inshore waters, and demersal species in the area.
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. Due to the offshore location of the Victoria infrastructure (87 km) suggests that there is unlikely to be any impact on tourism.

Socioeconomic receptor	Impacts to socioeconomic receptors at risk in the Victoria area
Shipping	Shipping density in the decommissioning area is recorded as very low (BEIS, 2017). 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. However, it is unlikely that there will be any long-term impacts on this industry.
Oil and gas	The oil and gas industry is well established in the North Sea. Although the 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 However, it is unlikely that there will be any long-term impacts on this industry.

9.4 Cumulative and Transboundary Impacts

Residual, cumulative and transboundary impacts expected as a result of an accidental oil spill event are summarised in the following sub-sections.

9.4.1 Cumulative Impacts

Cumulative effects arising from the proposed decommissioning activities have the potential to act additively from other oil and gas activities. The Victoria area is an extensively developed area, including both existing activities and new activities, and may act additively with those of other human activities (e.g. fishing and marine transport of crude oil and refined products) (DTI, 2004).

Any hydrocarbon discharge as a result of the proposed decommissioning activities 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 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.

9.4.2 Transboundary Impacts

The spill will cross the UK/ Netherlands median line. In the event of any oil slick crossing it the Maritime and Coastguard Agency (MCA) Counter Pollution and Response Branch has agreements with equivalent organisations in other North Sea coastal states, under the Bonn Agreement 1983. Applicable international arrangements are further described in Appendix A.

9.5 Proposed 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 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.

The response to all spills is detailed in the Victoria subsea well OPEP (Verus Petroleum, 2014). Table 9-6 lists the planned measures to prevent or reduce the likelihood of a spill occurring during the proposed decommissioning activities. Based on the estimated volumes of diesel, the NEO 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 9-6. Oil spill mitigation measures for potential spill scenarios occurring during decommissioning activities

Potential source of impact	Planned mitigation measures
All oil spills	The Victoria subsea well OPEP (Verus Petroleum, 2014) has 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. The OPEP details 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 size of the spill: 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.
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 Shipboard Oil Pollution Emergency Plan (SOPEP).

9.6 Conclusions

The conclusions from the impact assessment for an accidental hydrocarbon release are that the:

- Worst-case scenario at the decommissioning area would result from a loss of diesel from on-site vessels;
- Diesel spills will disperse and dilute quickly, without reaching coastline;
- Probability of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area; and
- Response in the OPEP will provide the direction to effectively manage the spill in case of an accidental event.

10 Environmental Management System

NEO has a Health, Safety and Environment Management System Framework, which has been developed to include all relevant safety, environmental and technical arrangements to fulfil NEO duties across its UKCS portfolio. The system follows the plan-do-check-act management system methodology to drive continual improvement and aligns to the commitments made in the HSE Policy and Corporate Major Accident Prevention Policy (CMAPP).

A four-tier structure sets out the NEO Policies, Standards, Company Procedures and documentation as illustrated in Figure 10-1.

In compliance with OSPAR 2003/5, the NEO Environmental Management was externally re-validated to OSPAR 2003/5 in 2014, 2016, 2018 and 2020.

There are a number of associated benefits with the installation EMS having OSPAR 2003/5 accreditation including, but not limited to, promoting continual improvement, maintaining a high internal environmental management standard and aligning to NEO's values and business principles.

NEO acknowledges that the proposed decommissioning activities have the potential for associated environmental impacts. As such, these require careful and responsible management to mitigate, where possible, their negative impact. NEO will ensure that any environmental risk is managed to as low as reasonably practicable.

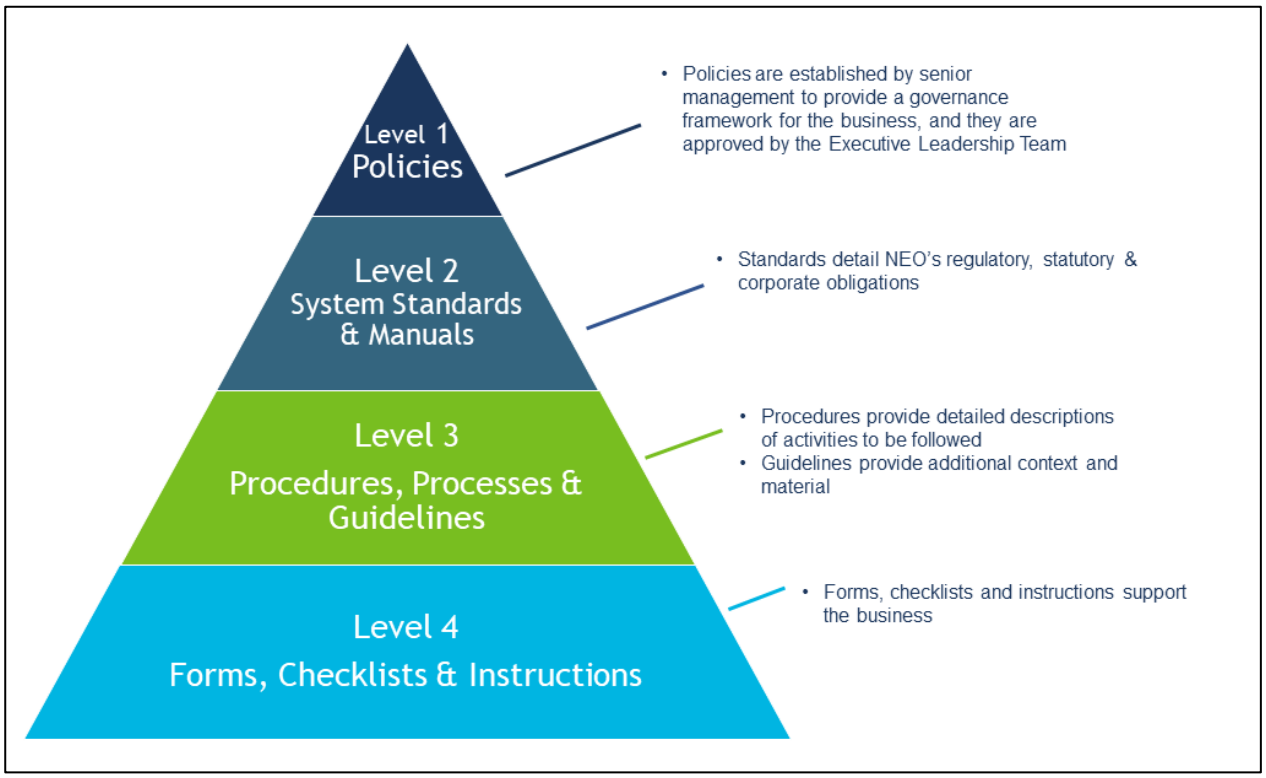


Figure 10-1: NEO HSE Management System

11 Conclusions

An EIA forms an integral part of the NEO EMS ensuring that adequate environmental considerations are incorporated into the DP for the Victoria installation. This EA presents the findings of the EIA, providing sufficient information to enable a robust evaluation to be made of the potential environmental and socioeconomic consequences of the proposed decommissioning activities.

The Victoria subsea infrastructure is located in a relatively sensitive area of the southern North Sea (Section 3):

- All four Annex II species (harbour porpoise, bottlenose dolphin, grey seals and harbour seals) known to occur in UK offshore waters have been sighted within Quadrant 49 and the surrounding quadrants of the Victoria Field; and
- The installation is located within the North Norfolk Sandbank and Saturn Reef SAC and Southern North Sea cSAC, which are designated for the protection of Annex I habitats (sandbanks which are slightly covered by sea water all of the time and biogenic reefs formed by cold water corals) and Annex II species (harbour porpoise), respectively.

Following the identification of the interactions between the proposed Victoria decommissioning activities and the local environment, the assessment of all potentially significant environmental and socioeconomic impacts, and key environmental concerns identified as requiring consideration for impact assessment (including those raised by stakeholders) were investigated in the following sections:

- Seabed impact (Section 5)
- Discharges to sea (Section 6)
- Societal impacts (Section 7)
- Accidental events (Section 8)
- Underwater noise (Section 9)

Mitigation to avoid and/or reduce the environmental concerns highlighted above is in line with industry best practice. NEO has an established EMS process (Section 10), which will ensure that proposed mitigation measures are implemented and monitored to achieve or better the outcome presented in this EA.

NEO intends to remove all exposed sections of pipework and umbilical and remove all mattresses and grout bags, where safe to do so. Only a crossing and the buried section of pipeline and umbilical, below 0.6 m in depth, therefore within the industry guidance of a clean seabed, will be decommissioned in situ, minimising any perceived risk to the environment or key stakeholders.

NEO 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 temporarily 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 2).

Activities resulting from the decommissioning of the Victoria subsea infrastructure are expected to create a maximum seabed impact of 0.029 km^2 (Section 5). The decommissioning of the pipeline and umbilical in situ is unlikely to have a significant impact on other sea users (i.e. fishing) due to a relatively short length of the pipeline and umbilical remaining in situ, buried below 0.6 m (Section 7). Furthermore, all operations will be notified to other users of the sea as per industry best practice and post decommissioning monitoring programme will be agreed with BEIS.

Underwater noise will be increased during decommissioning mainly due to the presence of vessels, but will be transient and is not expected to have a significant or cumulative impact, as the sound level and area of influence are expected to be below any significant threshold. It is considered due to stakeholders concerns, as activities are located in the harbour porpoise protection area (Section 9).

Other than a minor contribution to overall local emissions, decommissioning activities are not anticipated to cause any transboundary impacts.

Overall, the EA has evaluated the environmental risk reduction measures and this document concludes that NEO 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 EA is that the recommended options presented for the decommissioning of the Victoria subsea infrastructure can be completed without causing significant adverse impact to the environment.

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Appendix 1 Legislation & Marine Policy

This appendix presents a summary of key regulatory drivers applicable to the Victoria decommissioning project. Its summaries the policy, legal and regulatory framework within which this EA has been undertaken.

Table A-1: Decommissioning

Regulator	Legislation	Summary of requirements
BEIS	Petroleum Act 1998	The Petroleum Act 1998 sets out requirements for undertaking decommissioning of offshore installations and pipelines including preparation and submission of a Decommissioning Programme.
	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 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.
	Marine and Coastal Access Act 2009	The MCAA will replace and merge the requirements of the Food and Environment Protection Act (FEPA) Part II (deposits to the sea) and the Coast Protection Act (navigation). Many offshore sector activities are exempt from the acts; however certain activities including deposits of substances or articles on the seabed during abandonment and decommissioning operations are covered. Application to BEIS for approval to disturb, recover or place items on the seabed can be made under the provisions of the MCAA using a Marine License.
BEIS, MMO, Scottish Government	The Energy Act 2016	The introduction of the Energy Act 2016 formally establishes the Oil and Gas Authority (OGA) as an independent regulator, detailing its functions. The regulations transfer functions from the Secretary of State for Business, Energy and Industrial Strategy (formerly DECC) to the Oil and Gas Authority (OGA). Functions relate to licensing, production and exploration.
BEIS/ HSE	Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 Pipeline Safety Regulations 1996 The Petroleum Act 1998	When decommissioning a field, operators should contact BEIS at least a year in advance of proposed pipeline works to discuss PWA Variation requirements and timings for submission of applications.
EA	The Environmental Permitting (England and Wales) Regulations 2010	Some facilities could harm the environment or human health unless they are controlled. The environmental permitting regime ('the regime') requires operators to obtain permits for some facilities, to register others as exempt and provides for ongoing supervision by regulators.
	The Environmental Protection Act 1990	In addition to the above, persons concerned with controlled waste are under a duty of care, under the EPA1990, to ensure that the waste is managed properly, recovered or disposed of safely, does not cause harm to human health or pollution of the environment and is only transferred to someone who is authorized to receive it. This duty applies to any person, who produces, imports, carries, keeps, treats or disposes of controlled waste or as a broker has control of such waste. Breach of the duty of care is an offence, with a penalty of up to £5000 on summary conviction or an unlimited fine on conviction on indictment.
BEIS	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 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.

Regulator	Legislation	Summary of requirements
OGA/ HSE	The Offshore Installations (Offshore Safety Directive) Regulations 2015	This regulation implements the requirements of Directive 2013/30/EU of the European Parliament and of the Council on safety of offshore oil and gas operations and amending Directive 2004/35/EC (the "Offshore Safety Directive"), which intends to reduce as far as possible the occurrence of major accidents related to offshore oil and gas operations (such as the 2010 Deepwater Horizon incident in the Gulf of Mexico) and to limit their consequences. The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 supersedes the Offshore Installations (Safety Case) Regulations 2005. Operators must prepare a Safety Case for offshore installations and the notification of specified activities to the competent authority (the Health and Safety Executive and the Secretary of State acting jointly). This incorporates operations through production and including decommissioning.
EA	Hazardous Waste (England & Wales) Regulations 2005	Depending on its nature and composition, waste may be defined as hazardous waste (in England and Wales) within the UK. Hazardous wastes are those that are potentially the most difficult and dangerous and are listed on the European Commission's List of Wastes. The Regulations contain strict rules for the storage, transport and disposal of hazardous wastes. For example, the regulations require all movement of hazardous waste to be tracked by way of a consignment note system.
	Transfrontier Shipment of Waste Regulations 2007	The international movement of waste is controlled by means of Council Regulation No 1013/2006/EC on shipments of waste (the "WSR"). The Transfrontier Shipment of Waste Regulations 2007 gives effect to certain aspects of the WSR into UK law, nominate the competent authorities for the UK and provide them with their respective enforcement powers. The UK Plan for Shipments of Waste sets out Government policy on shipments for disposal. The Regulations are enforced by the Environment Agency ((EA) England and Wales), Scottish Environment Protection Agency ((SEPA) Scotland) and Northern Ireland Environment Agency ((NIEA) Northern Ireland). The regulations apply to decommissioned offshore installations. The Secretary of State is the competent authority for the offshore area. Operators should consult the appropriate Agency when considering decommissioning activities that involve transboundary movements of waste.
	Radioactive Substances Act 1993, Amendment (Scotland) Regulations 2011 and the Environmental Permitting (England and Wales) Regulations 2010 as amended (2015)	The Radioactive Substances Act 1993 has been superseded by the Environmental Permitting (England and Wales) Regulations 2010 (as amended in 2015) in England and Wales. Anyone who receives radioactive sources or radioactive waste for disposal is subject to the requirements of the Radioactive Substances Act 1993 (RSA 93) as superseded by the Environmental Permitting (England and Wales) Regulations 2010 (as amended). Under these regulations they must have an authorisation from the appropriate regulatory body (EA in England & Wales) for the accumulation, storage or disposal of radioactive waste or be able to demonstrate compliance with the conditions contained in specific exemption orders. The Regulations apply to offshore installations and the preparation of a decommissioning programme and should identify whether the selected disposal route requires such an authorisation and that the selected facility has one. It is likely that new disposal routes will require an application for authorisations.
EA	Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008	The Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008 (TFSRWR 2008) transpose Council Directive 2006/117/Euratom on the supervision and control of shipments of radioactive waste and spent fuel. TFSRWR 2008 makes it an offence to ship radioactive waste or spent fuel into or out of the UK unless authorised by the appropriate authority. The new Regulations came into force on 25 December 2008 and are administered by the EA in England and Wales, SEPA in Scotland and the Chief Inspector in Northern Ireland. They replace and revoke the previous UK regulatory regime (The Transfrontier Shipment of Radioactive Waste Regulations 1993) and some transfers of radioactive waste across international boundaries which were previously regulated are now exempted.

Regulator	Legislation	Summary of requirements
HSE	Dangerous Substances in Harbour Areas Regulations 1987	The carriage, loading, unloading and storage of all classes of dangerous substances in port areas are controlled under the dangerous Substances in Harbour Areas Regulations 1987 (and amendments) and the Waste Management Licensing Regulations 1994.
OSPAR/ BEIS	OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations	Lays down the general principle of forbidding the dumping and the leaving wholly or partly in place of disused **offshore installations** in the maritime area covered by the OSPAR Convention. The Decision recognises potential difficulties in removing large steel jackets weighing more than 10,000 tonnes and concrete gravity base structures and provides a facility for derogation from the main rule of complete removal such that leaving the jacket footings or concrete structure in place may be considered.
OSPAR/ BEIS	OSPAR Recommendation 2006/5 on a management scheme 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. This Recommendation entered into force from 30 June 2006.
BEIS	Guidance Notes. Decommissioning of Offshore Oil and Gas Installations and Pipelines, May 2018.	Updated guidance notes for advising operators, licenses and contractors with guidance on the regulatory requirements for decommissioning in accordance with obligations set out in the Petroleum Act. These update the previous 2009 version.
IMO	International Maritime Organisation (IMO) Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone 1989	These Guidelines and Standards represent the "generally accepted international standards" as mentioned in the United Nations Convention on the Law of the Sea (UNCLOS), Article 60, which prescribes that any installations or structures which are abandoned or disused shall be removed to ensure safety of navigation and to prevent any potential effect on the marine environment.

Table A-2: Environmental impact assessment

Regulator	Legislation	Summary of requirement
BEIS	Council Directive on the Assessment of the Effects of Certain Public and Private Activities on the Environment - 85/337/EEC (the EIA Directive) as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC. EC Directive 2014/52/EU, amending EC Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment	The EIA Directive (85/337/EEC) has been in force since 1985 and applies to a wide range of defined public and private projects, which are defined in Annexes I and II: Annex 1: all projects listed in Annex I are considered as having significant effects on the environment and require a mandatory EIA. Typical projects include, for example: Extraction of petroleum and natural gas for commercial purposes where the amount extracted exceeds 500 tonnes/ day in the case of petroleum and 500,000 cubic metres/ day in the case of gas. Pipelines with a diameter of more than 800 mm and a length of more than 40 km: For the transport of gas, oil, chemicals; and For the transport of CO_2 streams for the purposes of geological storage, including associated booster stations. Installations for storage of petroleum, petrochemical, or chemical products with a capacity of 200,000 tonnes or more. The EC Directive 2011/92/EU (as amended by Directive 2014/52/EU) revokes the 85/337/EEC and 97/11/EC Directives and amends the 2003/35/EC directive. The 2012/92/EU lists two classes of project to which the Directive applies: Annex 1 Projects for which environmental assessment is mandatory; and Annex 2 projects for which EA is discretionary. Under 2012/92/EU, oil and gas developments are listed as Annex 1 projects. Directive 2014/52/EU makes provision for improvements to the EIA procedure. Significant changes are also made to Annex 3 and 4, with new Annex 2a detailing information that needs to be provided when determining whether projects listed in Annex II require an EIA. Member States are required to implement the provision of this Directive no later than 16th May 2017.

Regulator	Legislation	Summary of requirement
	The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 as amended (2007)	These Regulations implement the EIA Directive with regard to the offshore oil and gas industry. The Regulations require an EIA and the associated public consultation document (ES) to be submitted for certain projects. Although there is currently no statutory requirement to undertake an EIA at the decommissioning stage, a decommissioning programme will nevertheless need to be supported by an EIA. The ES submitted for the development under the EIA regulations requires the applicant to consider the long-term impacts of the development and these include the impacts arising from decommissioning.
	The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017	These Regulations offer further amendments to The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) (see above). The amendments are under the interpretation of certain regulations, which addresses the requirements of the contents of licence, agreement of projects, provisions to directions over Environmental Statements, projects which have transboundary impacts, and generally the contents, exemptions, and criteria of environmental statements. In regards the amendments to the pipe-line regulations, the amendments are again under the provision, content and determinations of environmental statements; their publicity, provision of information, information and evidence, projects which affect other states and the concert to pipeline works.
	OSPAR Recommendation 2010/5 on assessments of environmental impact in relation to threatened and/or declining species and habitats	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 maritime area are prepared, Contracting Parties should ensure they take account of relevant species/ habitats on the OSPAR List of threatened and/or declining species/ habitats (OSPAR Agreement 2008/6).

Table A-3: Territorial waters

Regulator	Legislation	Summary of requirements
-	Territorial Sea Act 1987 Territorial Waters Order	Defines the extent of the territorial sea adjacent to the British Islands.

Table A-4: Atmospheric emissions

Regulator	Legislation	Summary of requirements
MCA	MARPOL 73/78 Annex VI the Prevention of Air Pollution from Ships	Annex VI is concerned with the control of emissions of ozone depleting substances, NOx, SOx, and 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 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; and emissions from diesel engines solely dedicated to the exploitation of mineral resources.
BEIS	The National Emission Ceilings Regulations 2002	There regulations transpose EC Directive on national emission ceilings for certain atmospheric pollutants 2001/81/EC into UK law and set national ceilings and a requirement for the development of a reduction programme for SOx, NOx and VOCs and set out the UK government commitment for achieving a reduction of atmospheric

Regulator	Legislation	Summary of requirements
		emissions by 2010 and thereafter not to exceed the amounts specified in the Schedule of that pollutant.
	The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 as amended (2010) Directive 2012/33/EU (amending Directive 1999/32/EC)	These regulations implement Annex VI of MARPOL (the International Convention for the Prevention of Pollution from Ships 73/78) in the UK. The 2010 Amendments primarily implement provisions concerning the sulphur content of marine fuels contained in Council Directive 1999/32/EC. The Directive sets maximum sulphur content for fuel including heavy fuel oil and gas oil including marine fuel.
BEIS	Climate Change Act 2008	The Act sets up a framework for the UK to achieve its long-term goals of reducing greenhouse gas emissions and to ensure actions are taken towards adapting to the impact of climate change. The Act enables a number of elements, including amongst others; setting medium and long-term emissions reduction targets in statute, introduction of a system of carbon budgeting which constrains the total amount of emissions in a given time period, a new reporting framework for annual reporting of the UK's greenhouse gas emissions, creation of an independent advisory body (the Committee on Climate Change). As a result of the Act and the 2009 Order, the current legally binding targets for the net UK carbon account are: 34% reduction by 2020 and 80% reduction by 2050, against a 1990 baseline.
	EU Regulation 517/2014 on Fluorinated Greenhouse Gases 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 timeframe for their phasing-out. Recently there has been the release of an amendment of the EU Parliament Regulation 517/2014, the Regulation (EU) 1375/2017 amending Implementing Regulation (EU) 1191/2014 determining the format and means for submitting the report referred to in Article 19 of Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases, which concerns the implementation and establishment of beat available techniques (BAT) in the management of industrial emissions.
	Regulation (EC) 1005/2009 on substances that deplete the ozone layer. Environmental Protection (Controls on Ozone-Depleting Substances Regulations 2011. The Ozone –Depleting Substances (Qualifications) Regulations 2009 The Ozone-Depleting Substances Regulations 2015	These regulations replace and consolidate the Ozone-Depleting Substances (Qualifications) Regulations 2009 (S.I. 2009/2016) and the Environmental Protection (Controls on Ozone Depleting Substances) Regulations 2011 (S.I. 2011/1543)). These Regulations make provision in the UK for EC Regulation 1005/2009 which controls the production, impact, export, placing on the market, recovery, recycling, reclamation and destruction of substances that deplete the ozone layer.

Table A-5: Access to environmental information and public participation

Regulator	Legislation	Summary of requirements
BEIS	Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 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.
	Public Participation Directive (PPD) 2003/35/EC	Provides for public participation in the preparation of environmental plans, programmes and projects with significant environmental impacts. See section on environmental impact assessment.

Table A-6: Conservation and biodiversity

Regulator	Legislation	Summary of requirements
BEIS	The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 as amended (2012)	These Regulations make provision for implementing the Birds Directive and Habitats Directive in relation to marine areas where the United Kingdom has jurisdiction beyond its territorial sea. The Regulations make provision for the selection, registration and notification of sites in the offshore marine area (European Offshore Marine Sites) and for the management of these sites. Competent authorities are required to ensure that steps are taken to avoid the disturbance of species and deterioration of habitat in respect of the offshore marine sites and that any significant effects are considered before authorisation of certain plans or projects. Provisions are also in place for issuing of EPS licences for certain activities and for undertaking monitoring and surveillance of offshore marine sites. The Amendment Regulations make various insertions for new enactments (e.g. new Birds Directive). Most recent amendments to the 2007 and 2010 regulations are The Conservation of Habitats and Species (Amendment) Regulations 2012. JNCC is an advisory body for these Regulations.
BEIS	The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 as amended (2007)	Secretary of State set out these Regulations to consider whether a “Habitats Regulatory Assessment” should be undertaken prior to granting a licence under the Petroleum Act 1998. Habitats Regulatory Assessment is the formal assessment by the Competent Authority of the impacts of a plan or project on the integrity of (a) Natura 2000 site(s). Habitats Regulatory Assessment is a process separate from the EIA requirements, but which should run alongside and concurrently with the EIA requirements. The 2007 amendments also extend this requirement to all UK waters. These regulations implement European Directives for the protection of habitats and species in relation to oil and gas activities carried out in whole or in part on the UKCS. In particular these are the Council Directive 92/43 on the conservation of natural habitats, wild fauna and flora and Council Directive 79/409 on the conservation of wild birds. The 2007 amendments extend the requirements to all UK waters. JNCC is an advisory body for these Regulations.
MMO/ EA	Marine and Coastal Access Act 2009	Marine Nature Conservation – Powers in the Marine and Coastal Access Act 2009 enable the designation of Marine Conservation Zones (MCZs) in the territorial waters adjacent to England and Wales and UK offshore waters. The purpose of these new conservation measures is to halt the deterioration of the state of the UK’s marine biodiversity and promote recovery where appropriate, support healthy ecosystem functioning and provide the legal mechanism to deliver our current European and international marine conservation commitments, such as those laid out under the Marine Strategy Framework Directive, OSPAR Convention and Convention on Biological Diversity.
EA	The EC Water Framework Directive, 2000	In December 2000 the 'Directive 2000/60/EC of the European Parliament established a framework for Community action in the field of water policy' (referred to as the Water Framework Directive or WFD). The purpose of the Directive is to establish a framework for the protection of inland and coastal waters. It ensures that all aquatic ecosystems meet 'good status' by 2015. Transposition into national law in the UK occurred through the following regulations: The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Statutory Instrument 2003 No. 3242) for England and Wales.

Table A-7: Emergency response

Regulator	Legislation	Summary of requirements
BEIS	The Offshore Installations (Emergency Pollution Control) Regulations 2002	The Regulations give the Representative of the Secretary of State for Energy and Climate Change (SOSREP) powers to intervene in the event of an incident involving an offshore installation where there is, or may be, a risk of significant pollution, or where an operator is failing or has failed to implement effective control and preventative operations.
	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 as amended (2011)	Under these Regulations, it is an offence to make an unlawful release of oil, i.e. a release of oil other than in accordance with the permit granted under these Regulations for oily discharges (e.g. produced water etc.). However, it will be a defence to prove that the contravention arose because of something that could not have been reasonably prevented, or that it was due to something done as a matter of urgency for the purposes of securing the safety of any person. PON 1 reporting.
	Merchant Shipping Act 1995	The Merchant Shipping Act 1995 implements in the UK the Oil Pollution Preparedness, Response and Co-operation (OPRC) Convention. 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 OPEP, which are approved by the body that is the National Competent Authority for the Convention.
	The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015	The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015 amend the existing requirements in the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 to have an oil pollution emergency plan. The 1998 Regulations make provision for certain facilities in the United Kingdom's internal waters, territorial sea and continental shelf to have an oil pollution emergency plan. The amendments extend the requirement to have an oil pollution emergency plan to non-production installations in the territorial sea and the continental shelf and apply further requirements to installations and their connected infrastructure which are carrying out offshore oil and gas operations, including decommissioning operations.

Table A-8: Environmental liability

Regulator	Legislation	Summary of requirements
EA	Directive 2004/35/EC of the European Parliament and the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage.	The Environmental Liability Directive 2004/35/EC(ELD) enforces strict liability for prevention and remediation of environmental damage to 'biodiversity', water and land from specified activities and remediation of environmental damage for all other activities through fault or negligence. The Directive defines "environmental damage" as damage to protected species and natural habitats, damage to water and damage to soil. Operators carrying out dangerous activities listed in Annex III of the Directive fall under strict liability (no need to proof fault). Operators carrying out other occupational activities than those listed in Annex III are liable for fault-based damage to protected species or natural habitats. The establishment of a causal link between the activity and the damage is always required. Affected natural or legal persons and environmental NGOs have the right to request the competent authority to take remedial action if they deem it necessary. The ELD was amended three times through Directive 2006/21/EC on the management of waste from extractive industries, through Directive 2009/31/EC on the geological storage of carbon dioxide and amending several directives, and through Directive 2013/30/EU on safety of offshore oil and gas operations and amending Directive 2004/35/EC. The amendments broadened the scope of strict liability by adding the "management of extractive waste" and the "operation of storage sites pursuant to Directive 2009/31/EC" to the list of dangerous occupational activities in Annex III of the ELD. The Offshore Safety Directive, containing an amendment to the ELD (extension of the scope of damage to marine waters), was adopted in June 2013.

Table A-9: Chemicals, drainage and oily discharge

Regulator	Legislation	Summary of requirements
BEIS	The Offshore Chemical Regulations 2002 as amended (2011)	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 Chemical Hazard Assessment and Risk management (CHARM) model. Applications for permits are made *via* the submission of the relevant PET system permit application (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. The principal aim is to make unlawful 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".
BEIS/ OSPAR	Convention for the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention) OSPAR Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings OSPAR Recommendation 2006/5 on a Management Regime for Offshore Cuttings Piles.	The OSPAR Convention (in particular Annex III) is the main driver for reductions in oily discharges to the North Sea. The UK as a contracting party to the Convention is therefore obliged to implement any Decisions and Recommendations made by the Commissions. Certain decisions made under the earlier Paris Convention also still stand. OSPAR Decision 2000/3 that came into effect on 16 January 2001 effectively eliminates the discharge of organic phase fluids (OPF) (oil based (OBF) or synthetic based (SBF) drilling fluids) or cuttings contaminated with these fluids. Use of OPF is still allowed provided total containment is operated. The use of diesel-oil-based drilling fluids is prohibited. The discharge of whole OPF to the sea is prohibited. The mixing of OPF with cuttings for the purpose of disposal is not acceptable. The discharge of cuttings contaminated with OBF (including SBF) greater than 1% by weight on dry cuttings is prohibited. The use of OPF in the upper part of the well is prohibited. Exemptions may be granted by the national competent authority for geological or safety reasons. The discharge into the sea of cuttings contaminated with synthetic fluids will only be authorised in exceptional circumstances. Authorisations to be based on the application of BAT/Best Environmental Practice (BEP). Best Available Techniques described within the Decision include recycling, recovery and reuse of muds. The OSPAR 2006/5 Recommendation sets out measures to reduce pollution from oil or other chemicals from cuttings piles.
MCA/ BEIS	The Merchant Shipping (Prevention of Oil Pollution) (Amendment) Regulations 2000	These Regulations give effect to Annex I of 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 UK Oil Pollution Prevention (UKOPP) or International Oil Pollution Prevention (IOPP) certificate. Vessels and drilling rigs are also required to hold a current, approved SOPEP which is in accordance with guidelines issued by the Marine Environment Protection Committee of the IMO.
	Merchant Shipping Act 1995 International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78	Arrangements for Survey and Certification Part VI of the Merchant Shipping Act, 1995 makes provision for the prevention of pollution from ships. It implements in the UK the requirements of MARPOL 73/78. MARPOL defines ships to include offshore installations and relevant provisions of MARPOL are applied to offshore installations. Annex 1 of MARPOL relates to prevention of oil pollution and has provisions for machinery space drainage that are applied to offshore platforms.

Regulator	Legislation	Summary of requirements
		Vessels of 400 GT or above (which includes a Floating Storage Unit (FSU)) are permitted to discharge processed water (i.e. Oily Drainage Water) from Machinery Space Drainage as long as the oil content without dilution, does not exceed 15 ppm of the oil in water.
BEIS	PARCOM Recommendation 86/1 of a 40 mg/l Emission Standard for Platforms	The PARCOM Recommendation 86/1 provision of a 40 mg/l performance standard for platforms is applicable, and remains in force for discharges of displacement water, drainage water and ballast water, which are not covered under MARPOL. The maximum concentration of dispersed oil must not exceed 100 mg/l at any time.
HSE	The REACH Enforcement Regulations 2008	These enforce Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) which require chemical users to demonstrate the safe manufacture of chemicals and their safe use throughout the supply chain. Under REACH, the users of chemicals as well as their manufacturers and importers have a responsibility to ensure that the risks to both human health and the environment are adequately assessed.
BEIS	The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 as amended (2011)	These Regulations replaced the Prevention of Oil Pollution Act 1971 (“POPA”) and are a mechanism to continue implementation on the UKCS of OSPAR Recommendation 2001/1. Discharges of reservoir oil associated with drilling from an FSU must be covered by an Oil Pollution Prevention and Control (OPPC) Term Permit, whereas discharges from a production installation are covered by an OPPC Life Permit. Operators are required to regularly report actual oil discharge in order that adequate monitoring can be achieved. These regulations do not apply to those discharges regulated under the Offshore Chemicals Regulations 2002, the Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 (as amended) or the Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008. Amendments in 2011, *via* the Offshore Chemicals Regulations and the Offshore Petroleum Activities (OPPC) Regulations 2010 introducing new concept of “release” and “offshore installation” which encompasses all pipelines. The concentration of dispersed oil in produced water discharges as averaged over a monthly period must not exceed 30 mg/l, whereas the maximum permitted concentration must not exceed 100 mg/l at any time. The quantity of dispersed oil in produced water discharged must not exceed 1 tonne in any 12-hour period.
	Offshore Pollution Liability Agreement as amended (1st April 2015)	Any UKCS oil and gas operator should have membership to OPOL. Each Party and applicant to become a Party shall provide to the Association evidence of its financial responsibility to fulfil its obligations under Clause IV of OPOL in accordance with the criteria and in the form set out in Form B of these Rules (subject to such changes as the Association may prescribe in cases where the Association has agreed that OPOL does not apply to all Offshore Facilities of which that Party and applicant is or becomes the Operator).

Table A-10: Waste handling and disposal

Regulator	Legislation	Summary of requirements
EA	International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 Annex V	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.
	Environmental Protection Act 1990	This Act, and associated regulations, introduces a "Duty of Care" for all controlled wastes. Waste producers are required to ensure that wastes are identified, described and labelled accurately, kept securely and safely during storage, transferred only to authorised persons and that records of transfers (waste transfer notes) are maintained for a minimum of two years. Carriers and waste handling sites require licensing. This Act and associated Regulations brought into effect a system of regulation for "controlled waste". Although the Act does not apply to offshore installations, it requires operators to ensure that offshore waste is handled and disposed of onshore in accordance with the "Duty of Care" introduced by the Act.
	Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives.	The European Parliament introduced a new Directive, 2008/98/EC, on waste and repealing certain Directives. The Directive lays down measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing overall impacts of resource use and improving efficiency of such use.
	The Environment Protection (Duty of Care) Regulations 1991	Under these Regulations any person who imports, produces, carries, keeps, treats or disposes of Controlled Waste has a duty to take all reasonable steps to ensure that their waste is handled lawfully and safely. Special/Hazardous Waste is a sub-category of Controlled Waste (see also Special Waste Regulations and Hazardous Waste Regulations).
	The Controlled Waste (England and Wales) Regulations 2012	This legislation does not strictly apply offshore. However, because the offshore disposal of garbage is prohibited then all wastes must be transferred on shore for disposal. Once onshore, the wastes must meet the requirements of onshore legislation when being disposed of. These regulations must therefore be considered offshore to allow onshore requirements to be met, for example the identification and appropriate documentation of these wastes. These regulations define household, industrial and commercial waste for waste management licensing purposes.
	The Merchant Shipping (Implementation of Ship-Source Pollution Directive) Regulations 2009	These Regulations implement Directive 2005/35/EC of the European Parliament and of the Council of 7th September 2005 on ship-source pollution and on the introduction of penalties for infringements. The Directive aims to achieve better enforcement of the requirements of the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL 73), as modified by the Protocol of 1978 (MARPOL 73/78).
	The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 as amended (2010)	These Regulations implement the requirements of MARPOL 73/78 Annex IV in the UK and apply to vessels including fixed or floating platforms which operate in the marine environment and came into force on 01 February 2009. They lay out the requirements for sewage system surveys and certification and the requirements of sewage systems with an exception for fixed installations at a distance of more than 12 nautical miles from the nearest land. They also identify the requirements for a garbage management plan, garbage record books and prohibit the disposal of various types of garbage into the marine environment and define enforcement action. The 2010 Amendments correct drafting errors.
	Hazardous Waste (England & Wales) Regulations as amended (2015)	Depending on its nature and composition waste may be defined as hazardous waste (in England and Wales) within the UK. Hazardous wastes are those that are potentially the most difficult and dangerous and are listed on the European Commission's List of Wastes. The Regulations contain strict rules for the storage, transport and disposal of hazardous wastes. For example, the regulations require all movement of hazardous waste to be tracked by way of a consignment note system.

Table A-11: Naturally Occurring Radioactive Material (NORM) contaminated waste (sand, sludge and scale) and radioactive waste

Regulator	Legislation	Summary of requirements
EA	Radioactive Substances Act 1993 The Environmental Permitting 2010 (England and Wales) Regulations as amended (2015)	Onshore and offshore storage and disposal of naturally occurring radioactive materials (NORM) is regulated under the Radioactive Substances Act. Operators are required to hold, for each relevant installation, an Authorisation to store and dispose of radioactive waste such as NORM scale which may be deposited in vessels and pipework. The authorisation specifies the route and methods of disposal. Records of disposal are required. The offshore use, storage and disposal of radioactive sources are regulated under the same legislation. A Registration Certificate is required to keep; transport and use sources and records must be kept. Additionally, different radionuclides have different activity thresholds over which the containing sources qualify as a High Activity Sealed Source (HASS). As of January 2008, and if applicable, HASS records must be reported to the EA and maintenance of an inventory is required. The Radioactive Substances Act 1993 has been superseded by the Environmental Permitting (England and Wales) Regulations 2010 (as amended in 2015) in England and Wales.

Table A-12: Environmental management systems

Regulator	Legislation	Summary of requirements
BEIS/ OSPAR	OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry	All Operators controlling the operation of offshore installations on the UKCS are required to have in place an independently verified Environmental Management System (EMS) designed to achieve: the environmental goals of the prevention and elimination of pollution from offshore sources and of the protection and 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 & EMS 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.

Table A-13: Licensing

Regulator	Legislation	Summary of requirements
BEIS	Petroleum Act 1998 as amended The Petroleum Licensing (Exploration and Production) (Seaward and Landward Areas) Regulations 2004 as amended (2006) The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008	These Regulations consolidate with amendments the provisions of the Petroleum (Production) Regulations 1982 (as amended) in relation to (a) applications to the Secretary of State for petroleum production licences in respect of seaward areas and (b) applications to the Secretary of State for petroleum exploration licences in respect of seaward areas and landward areas below low water line. This Act vests all rights to the nation's petroleum resources to the Crown and provides the basis for granting licences to explore for and produce oil and gas. Production licences grant exclusive rights to the holders to “search and bore for and get petroleum” in specific blocks. Licences generally contain a number of environmental restrictions and conditions. Under the terms of a Licence, licence holders require the authorisation of the Secretary of State prior to conducting activities such as installing equipment or drilling of wells in the licence area. Consent to flare or vent hydrocarbons is also required from BEIS under the terms of the Model Clauses incorporated into Production Licences. License conditions will include environmental issues e.g. time constraints in sensitive areas. The model clauses of the license require the licensee to appoint a fisheries liaison officer.
	Marine & Coastal Access Act 2009	The Marine & Coastal Access Act 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.

Table A-14: Ballast water

Regulator	Legislation	Summary of requirements
MCA	International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Management - BWM) – adopted 2004	Objective to prevent, minimise and ultimately eliminate the transfer of harmful aquatic organisms and pathogens though control and management of ships’ ballast water and sediments. Helsinki and OSPAR Commissions General Guidance on the Voluntary Interim has set out an application of the D1 Ballast Water Exchange Standard. Under this regulation, all tankers > 150 GRT and all ships > 400 GRT in the UK are required to have in place UKOPP or IOPP Certificate and Ballast Water Exchange Management plan. It is required all vessels entering the North East Atlantic to exchange the ballast water at least 200 miles from the nearest land and at least 200 metres deep.

Table A-15: Transboundary impacts

Regulator	Legislation	Summary of requirements
BEIS	Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991)	The 1991 UNECE Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention) requires any country that has ratified the convention to consider the transboundary environmental effects of industrial projects and activities, including offshore hydrocarbon exploration and productions activities. The Convention requires that if the activity is found to cause a significant adverse transboundary impact then the party undertaking the activity shall, for the purpose of ensuring adequate and effective consultations, notify any potentially affected country as early as possible.

Table A-16: Location of structures

Regulator	Legislation	Summary of requirements
BEIS	Energy Act 2008 Part 4A	The provisions of the Coast Protection Act were transferred to the Energy Act 2008 Part 4A by the MCAA 2009 and Marine Scotland Act 2010 (MSA) to cover navigation considerations relating to exempted exploration or production/storage operations. Consent to locate provisions of the Energy Act Part4A came into force in April 2011. On 11th October 2012 DECC launched its consultation on the Part 4A consenting provisions. Section 77 of the MCAA excludes the vast majority of offshore oil and gas operations and carbon dioxide storage operations controlled under The Petroleum Act 1998 (PA) or The Energy Act 2008 (EA). To maintain the Consent to Locate provisions for these excluded operations, Section 314 of the MCAA created a new Part 4A of the EA, transferring the provisions of Section 34 of the CPA to the EA and transferring regulatory competence from DfT to DECC. On 5th June 2013 DECC published its response to consultation on the Part 4A consenting provisions. Full implementation of the Consent to Locate (CtL) regime under Part 4A of the EA commenced on Friday 7th June 2013.
	Continental Shelf Act 1964	This act extends the UK government's right to grant licences to explore and exploit the UKCS.
	The Continental Shelf (Designation of Areas) (Consolidation) Order 2000	This Order consolidates the various Orders made under the Continental Shelf Act 1964 which have designated the areas of the continental shelf within which the rights of the United Kingdom with respect to the sea bed and subsoil and their natural resources are exercisable
	Marine and Coastal Access Act 2009	The MCAA replaced and merged the requirements of FEPA Part II (deposits to the sea) and the Coast Protection Act 1949 (navigation). The licensing provisions of this Act entered into force in April 2011.

Appendix 2 Energy Use & Atmospheric Emissions

Following assumptions were made when calculating energy use and atmospheric emissions during Victoria 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 Victoria decommissioning activities.
- The estimates of energy and emissions of infrastructure decommissioning and flushing activities at Victoria Field have been assessed as one entity.
- A round trip by helicopter to the centre of the Victoria area takes, approximately, an hour.
- A Super Puma MK II helicopter has been assumed for this assessment. This model uses on average, 0.467 tonnes of aviation fuel per hour.
- 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. As the contract for waste management has not been confirmed, an assumption has been made that the disposal, recycling and treatment site will be in Ipswich, 112.5 km from the shipping yard in Great Yarmouth. As worst-case scenario it was assumed that the round trip will be 225 km.
- Material is transported by lorry with a capacity of, approximately, 33 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.
- 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. Therefore, this will 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.

Following energy factors were applied:

Table B-1: Energy consumption and gaseous emissions factors used in the calculations for the recycling of materials

Material	Energy consumption (GJ/ tonne)	Gaseous emissions (kg/ tonne)				Source
		CO_2	NOx	SO_2	CH_4	
Standard steel	9	960	1.6	3.8	ND	IoP (2000)
Copper	25	300	ND	120	ND	IoP (2000)
Aluminum	15	1,080	1.3	1.7	ND	IoP (2000)
Plastic	3.6	ND	ND	ND	ND	University of Bath (2008)

Table B-2: Energy consumption and gaseous emissions factors used in the calculations for the new manufacture of materials

Material	Energy consumption (GJ/ tonne)	Gaseous emissions (kg/ tonne)				Source*
		CO_2	NO_x	SO_2	CH_4	
Standard steel	25.0	1,889	3.5	5.5	ND	IoP (2000)
Copper	100.0	7,175	20	200	ND	IoP (2000)
Plastic	77.0	ND	ND	ND	ND	IoP (2000)
Aluminum	215.0	3,589	4.1	24.9	ND	University of Bath (2008)

Table B-3: Energy consumption and gaseous emissions factors used in the calculations for fuel use

Fuel type	Energy consumption (GJ/tonne)	Gaseous emissions (kg/tonne)				Source
		CO_2	NOx	SO_2	CH_4	
Marine diesel	43.1	3,200	59.0	4	0.270	IoP (2000)
Aviation fuel	46.1	3,200	12.5	4	0.087	IoP (2000)
Diesel fuel	44.0	3,180	40	1	No data	IoP (2000)

Table B-4: Energy consumption factors used in the calculations for vessel fuel consumption

Vessel	Fuel consumption (tonnes/day)				Source/ comments
	Mob/ demob	In transit	Working	Waiting on weather	
Supply vessel	1.5	8.8	6.4	6.4	Provided by NEO
CSV	1	11.2	4.5	4.5	Provided by NEO
DSV	8	30	15	18	Provided by NEO
Survey vessel	3	22	18	10	IoP (2000) factors for Remotely Operated Vehicle Support Vessel (ROVSV)
PSV	2	26	18	9	IoP (2000) factors for Multi Support Vessel
Jack-up rig	5	25	20	15	Provided by NEO