Victoria Field:
Decommissioning Environmental Appraisal

NEO-VC-OP-PLN-0002

Rev: 05

Final Version

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Document Control

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Revision Control

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B1	Revised and updated draft	OPRED comments addressed and outcome from CA and Environmental Appraisal (EA) included	31/07/2018
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Contents

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
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
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
DOB	Depth of Burial
DOC	Depth of Cover
DP	Decommissioning Programme
DSV	Dive Support Vessel
DTI	Department of Trade and Industry

Acronym	Definition
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
LCTP	Low Carbon Transition Plan
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
MBES	Multibeam Echo Sounder
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

Acronym	Definition
PARCOM	Paris Commission
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
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*	Decommissioned 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 0.5 mm.
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

In accordance with the Petroleum Act 1998 and on behalf of the Section 29 notice holders, NEO Energy (NEO) an established United Kingdom Continental Shelf (UKCS) operator, is applying to the Department for Business, Energy and Industrial Strategy (BEIS) and specifically the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) to obtain approval for decommissioning the Victoria pipeline and associated subsea infrastructure.

NEO ceased production from the Victoria Field, situated in United Kingdom Continental Shelf (UKCS) Block 49/17 of the southern North Sea (SNS; Figure 0-1) in January 2016 and as such, is preparing two Decommissioning Programmes (DPs):

DP1 Decommissioning of the Victoria Field Subsea Installation; and

DP2 Decommissioning of the Victoria Pipeline and Umbilical

This Environmental Appraisal (EA) presents the findings of the environmental impact assessment (EIA) undertaken in support of the Victoria DPs. The purpose of the EIA 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 EIA.

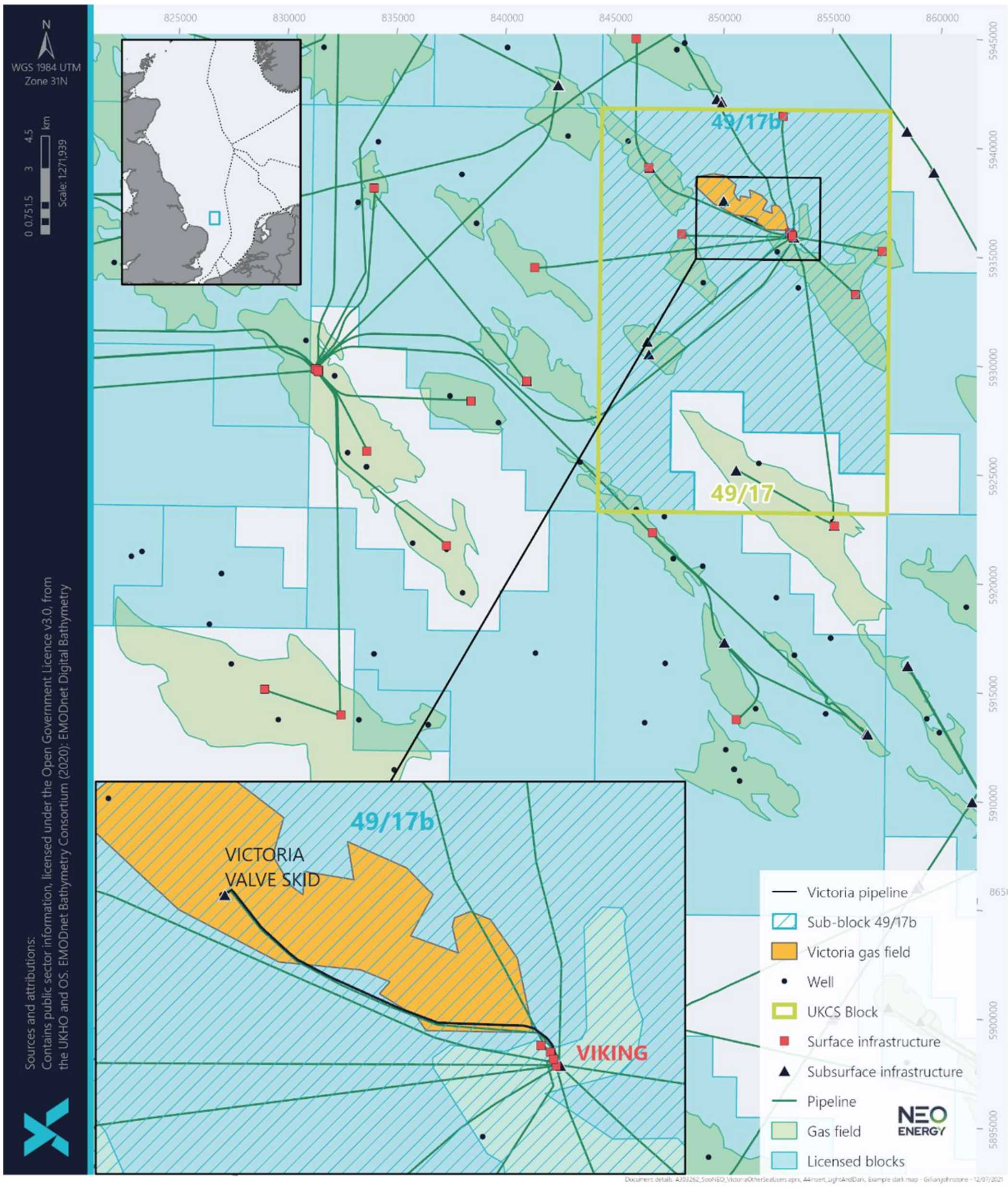


Figure 0-1 Location of the Victoria Field infrastructure

0.1 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 DP, which must be approved by BEIS before the owners of an offshore installation or pipeline may proceed with decommissioning.

Under the Guidance Notes: *Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998* (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).

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 and any midline exposures. Of the technically feasible pipeline flushing options, the CA determined that the preferred option would be to use a Dive Support Vessel (DSV) 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.

0.2 Project Overview

The Victoria Field was discovered in January 2007 by Silverstone Energy. The exploration well, 49/17-14, was subsequently plugged and abandoned. 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 Harbour Energy owned Viking BD platform, some 3.8 km away. Production commenced in October 2008, with gas being exported to the Theddlethorpe terminal via the Harbour Energy operated Viking B complex. Cessation of Production (CoP) was approved (and occurred) in January 2016. Offshore decommissioning activities are expected to commence in June 2022 .

The Victoria subsea decommissioning campaign is scheduled to occur between June and July 2022, followed by a P&A campaign in August 2022. The aim being to submit a close-out report to OPRED by the end of Q4 2022 (6). Should the project be delayed, the same schedule will be followed in 2023, with close-out report submission expected by the end of Q4 2023.

0.3 Scope of Victoria Decommissioning Programmes

The infrastructure covered by DP1 and DP2 and this EA is shown in Figure 0-2. This includes:

DP1:

- The Victoria (49/17-14a) wellhead, xmas tree and integrated protection structure
- The Victoria valve skid
- Concrete mattresses and grout bags

DP2:

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

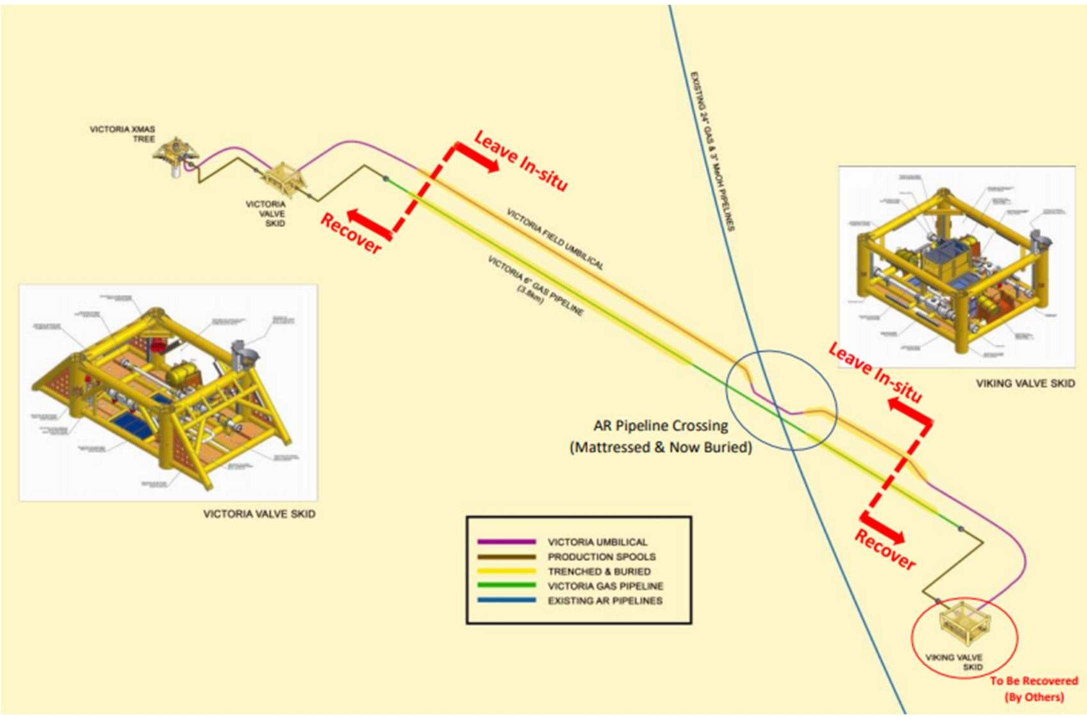


Figure 0-2 The Victoria Field infrastructure for decommissioning

With the exception of the physical removal of the integrated Victoria wellhead protection structure (WHPS), the activities associated with well plugging and abandonment (P&A) will be subject of a future well intervention application (WIA) via the BEIS Portal Environmental Tracking System (PETS) system. The Viking BD valve skid (Figure ii) is being decommissioned by Harbour Energy and is therefore not part of this scope.

Following flushing of the pipeline with seawater from a DSV, the concrete mattresses used previously to stabilise and/or protect the pipeline within the trench transitions will be removed at both Viking and Victoria pipeline ends, followed by localised dredging/jetting to expose the 6-inch pipe at the intended cut locations. Once sufficient access has been gained, either hydraulic cutting shears or a diamond wire cutting machine will be deployed to physically sever the pipe. All items recovered will be lifted to the DSV for transport to shore. Where deemed necessary, exposed sections of pipeline and umbilical will also be further exposed, cut and removed using the same methods.

With the first cut being at the start of the trench transition the remaining and now exposed free end of the pipeline should be at, or near, full trench depth thus presenting no impedance to fishing activity. Should the pipe be at a shallower depth than expected, then further localised dredging/jetting would be performed to lower the free end to at least 0.6m below the seabed. Based on visual evidence to date, it is also expected that sediment infill of any trenches will occur by natural means leading to further burial of the pipe ends. The pipeline crossing over the Viking AR pipeline is covered by mattresses and is buried. This will also be decommissioned *in situ*.

Well P&A activities will be carried out using a jack-up drill rig. Tubing will be removed and an environmental plug will be installed to isolate the well, following which the wellhead, xmas tree and integrated wellhead protection structure will be removed from the seabed. As mentioned previously, with the exception of the physical removal of the wellhead, xmas tree and integrated WHPS, the activities associated with the well P&A will be covered by a future WIA.

Visual as-left seabed surveys will be performed prior to close-out and ongoing inspections will be carried out on a schedule agreed between NEO and OPRED.

0.4 Environmental Settings & 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 (Table 0-1) and socioeconomic environment (Table 0-2) both within the United Kingdom Continental Shelf Block 49/17 (the block of interest), and in the wider southern North Sea area.

Table 0-1 Key environmental characteristics and sensitivities within the vicinity of the Victoria Field

Aspect	Characteristics
Site overview	The Victoria subsea infrastructure is located within Block 49/1, 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 49/17 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. The harbour porpoise is a designated feature of the Southern North Sea SAC.
Marine protected areas	
North Norfolk Sandbanks and Saturn Reef SAC	Victoria subsea infrastructure located within this SAC. The conservation objective of this site is to maintain site integrity to maintain Favourable Conservation Status (FCS) for Annex I protected sandbanks which are slightly covered by sea water all of the time and Annex I protected reefs.
Southern North Sea SAC	Victoria subsea infrastructure located within this SAC. The conservation objective of this site is to maintain site integrity to maintain FCS for Annex II protected harbour porpoise species.
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 49/17 are classified as very poorly to moderately well sorted, fine sand to fine gravel with low content of silt/ clay and organic matter (ConocoPhilips, 2015).
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	NS*	NS*	NS*	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 0-2 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 2019 was dominated by demersal species. Between 2015 and 2019, the annual total live weight of fish landed from ICES rectangle 35F2 ranged from a maximum of 1,102.88 tonnes in 2017 to a low of 10.13 tonnes in 2018; these catches had a value of £2,169,216 and £20,091 respectively. 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	Oil & Gas structures in the vicinity of the pipelines include 7 wells and 22 pipelines are located within 100 m radius from the Victoria subsea infrastructure.
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 50 km of the Victoria subsea infrastructure.
Windfarms	There are five known areas of windfarm development within 50 km of the Victoria subsea infrastructure. Three of these developments are in the pre-planning stages and two are operational.
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.

0.5 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, some 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 of interaction with receptors) 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, which have also been assessed against any existing environmental standards and relevant conservation objectives.

A summary of the main findings of the environmental impact assessment process is provided in the proceeding sections.

0.5.1 Atmospheric Emissions & Energy Use

Energy use and associated emissions resulting from the proposed Victoria Field decommissioning activities are mainly attributed to vessel use. Standard mitigation measures have been identified to minimise energy usage by project vessels and as such, 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. The total annual CO_2 emissions from offshore oil and gas UKCS operations during 2018 were 13.2 million tonnes. The estimated CO_2 emissions released during the decommissioning of the Victoria infrastructure and flushing operations represent approximately 0.04% of this total (Oil and Gas UK, 2019).

NEO is committed to Net Zero and the OGA Stewardship Expectation 11. NEO's Strategy to reduce emissions is intended to drive increased energy efficiencies and reduced emissions. NEO plans several improvements under our Strategy including the release of a Low Carbon Transition Plan (LCTP), which reviews carbon intensity and emissions at asset level, identifies operational efficiencies (minimising flaring and venting, tackling methane emissions and smart decommissioning methods. NEO are also committed to collaboration with partners and industry associations to explore alternative power solutions, including full or partial electrification and technological development.

0.5.2 Seabed Impacts

Decommissioning operations at the Victoria Field will result in work being undertaken at or near the seabed. All work will be undertaken within the boundaries of the North Norfolk Sandbanks and Saturn Reef SAC which is protected for Annex I protected sandbanks which are slightly covered by sea water all of the time and Annex I protected reefs.

The excavating, cutting and lifting of the Victoria subsea installations and pipelines (where proposed) will create a temporary disturbance of the seabed sediments, over an estimated area of 0.007 km^2, representing 0.00019% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC and 0.000019% of the Southern North Sea SAC. This disturbance will be relatively small and occur due to jetting activities (where required), 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 equipment, thereby minimising the risk of sediment disturbance. Recovery of the seabed and associated fauna following the removal of the subsea installations is expected to take approximately one year.

Given the shallow depth of the seabed, large areas of the SNS are unsuitable for the use of semi-submersible vessels (DECC, 2015). A jack-up rig is therefore the only suitable technology that can be utilised for the removal of the Victoria integrated WHPS and will be placed adjacent to the Victoria wellhead during decommissioning operations. Following the placement of the spudcans on the seabed, it is possible that gravel stabilisation material may be required to prevent scour and help stabilise the rig. Every endeavour will be made to avoid this requirement, including pre-loading of the rig to simulate maximum loads, frequent ROV inspections, re-levelling of the rig and re-positioning of the spudcans.

Of two previous rig placements at the same location, one recorded incident of scour occurred after 17 days of a 45-day operation in 2008. Mitigation measures included re-levelling of the rig, however, after 24 days, rig settlement was outwith acceptable operational limits and gravel was placed over the spudcans. As the planned duration of the Victoria well decommissioning scope is 20 days it is unlikely that scour mitigation will be required.

In the unlikely scenario that stabilisation is required, the placement of a maximum of 3,000 Te of gravel would create some permanent, yet recoverable, disturbance of seabed sediments, over an estimated area of 0.0006 km^2, representing 0.000016% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC and 0.0000016% of the Southern North Sea SAC. Gravel would be carefully placed with a flat profile and given the dynamic seabed conditions in this area of the SNS, reburial and recovery of the surface seabed and associated fauna is expected to take a maximum of two years, in line with observed mattress reburial in the vicinity of the WHPS. MBES survey data (ODE Asset Management, 2021) from the area directly adjacent to the WHPS also shows no indication of the gravel placed on the spudcans during the 2008 campaign. As such, although the introduction of stabilisation material into the SACs would be a permanent addition of hard substrate, it is expected that the seabed would recover and it is not expected that any conservation objectives pertaining to the structure of the sandbanks or the habitat of harbour porpoise prey will be compromised by the proposed well decommissioning activities.

Dredging, jetting and trenching operations at the pipeline and umbilical ends and where exposures have been removed would be expected to physically disturb the seabed sediments and benthos in the immediate vicinity of operations. The remaining and open trench transition profiles shall thereafter rely on natural backfill to provide infill. The temporary seabed disturbance associated with the excavation of the pipeline/umbilical ends and exposed sections is estimated to be 0.005 km^2. The alternative option of employing rock remediation over these areas was rejected on the basis that NEO consider rock placement to a highly unlikely scenario, and that this would be an additional and permanent change in substrate type within the North Norfolk Sandbanks and Saturn Reef SAC.

Other projects contributing to the cumulative impact within the North Norfolk Sandbanks and Saturn Reef SAC and Southern North Sea SAC include a number of oil and gas and renewable developments. In combination with the Victoria P&A and decommissioning activities outlined herein, an anticipated 37.88 km^2 of each SAC is expected to be temporarily impacted. A total 0.78 km^2 of permanent impact is also expected. Overall, a cumulative 1.07% of the North Norfolk Sandbanks and Saturn Reef SAC and 0.1% of the Southern North Sea SAC is thought to be affected by current and future developments.

0.5.3 Discharges to Sea

The flushing and flooding of the pipeline and umbilical will introduce hydrocarbon gas with minimal condensate and 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 plastics and 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. Discharges to sea will not impact the conservation features of the SACs.

0.5.4 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. Following decommissioning, potential damage or loss of demersal fishing gear will be negligible due to the burial of the pipeline and umbilical cut ends and the removal of exposed sections, and the undertaking of debris and clear seabed surveys directly after decommissioning.

0.5.5 Underwater Noise

The subsea noise levels generated by surface vessels and cutting apparatus 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 DP 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 affect fish behaviour to the extent that it would be noticeable at a population level. The individual and cumulative impacts from decommissioning activities at Victoria Field are not considered significant and will not compromise the conservation features of the southern North Sea SAC, specifically maintaining Favourable Conservation Status (FCS) for harbour porpoise.

0.5.6 Accidental Events

A release of hydrocarbon gas with a small percentage of gas condensate 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 negligible and will not contribute to the overall spill risk in the area. The current oil pollution emergency plan (OPEP) for the Victoria Field will provide effective spill management in the case of an accidental event.

0.6 Environmental Management

The Victoria decommissioning will be undertaken in accordance with NEO’s Health, Safety and Environment Management System (HSEMS) Framework. The system follows a plan, do, check, act model to align with HS(G)65 and ISO 14001. In compliance with OSPAR Recommendation 2003/5 to promote the Use and Implementation of Environmental Management Systems by the Offshore Industry, NEO obtain biannual independent verification of the Environmental Management System (EMS).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.

0.7 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) or adversely affect the conservation objectives of any protected sites 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 Programme and its 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 49/17 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).

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 Harbour Energy owned Viking BD platform, some 3.8 km away. Production commenced in October 2008, with gas being exported to the Theddlethorpe terminal via the Harbour Energy operated Viking B complex. Cessation of Production (CoP) was approved (and occurred) in January 2016.

1.3 Scope of the Proposed Decommissioning Operations

In accordance with the Petroleum Act 1998 and on behalf of the Section 29 notice holders, NEO Energy (NEO) an established United Kingdom Continental Shelf (UKCS) operator is applying to the Department for Business, Energy and Industrial Strategy (BEIS) and specifically the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) to obtain approval for decommissioning the Victoria pipeline and associated subsea infrastructure.

This EA supports the two Decommissioning Programmes (DPs):

DP1: Decommissioning of the Victoria Field Installations; and

DP2: Decommissioning of the Victoria Pipeline and Umbilical.

The infrastructure covered by DP1 (Section 1.3.1) and DP2 (Section 1.3.2) and this EA is shown in Figure 1-2.

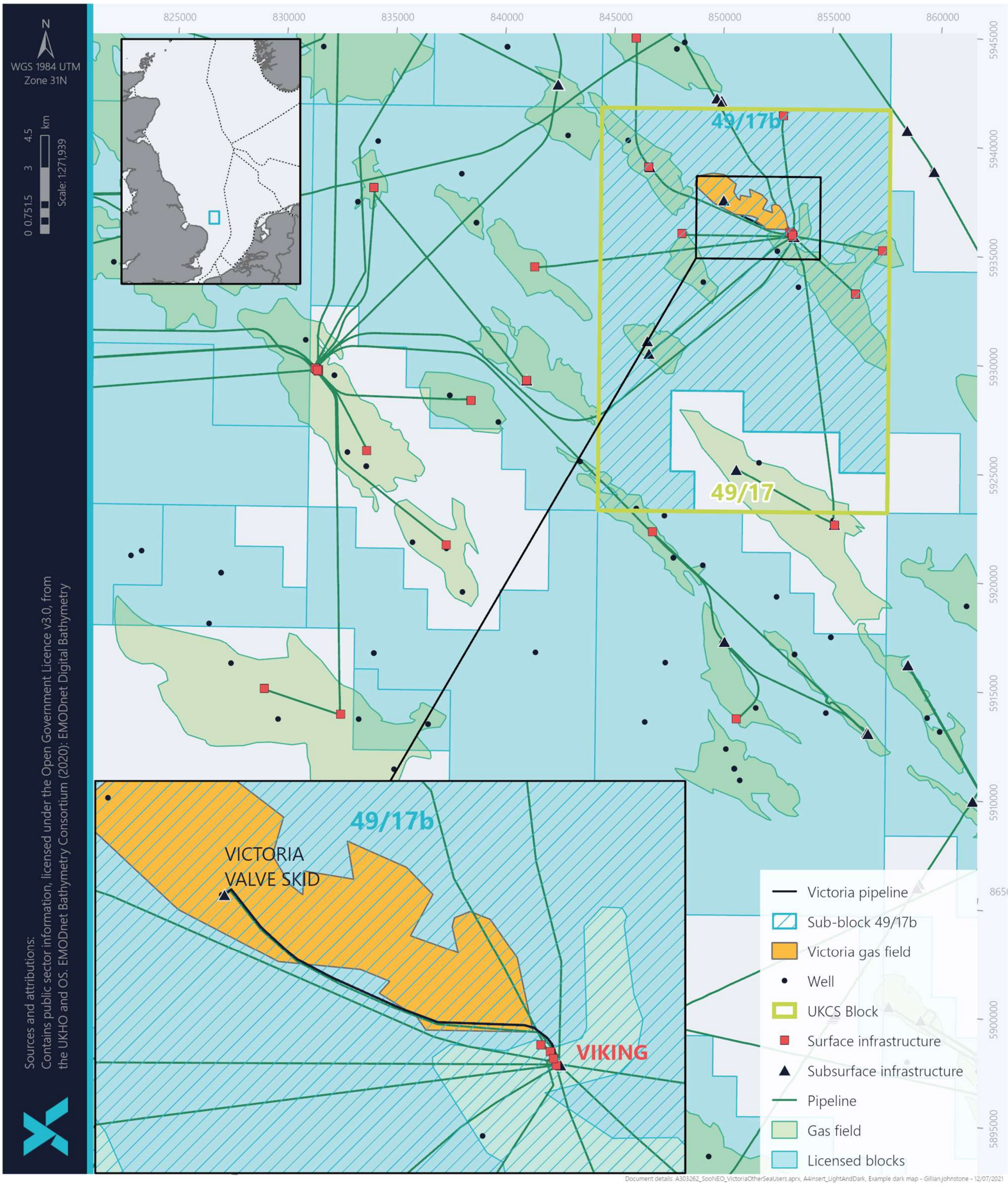


Figure 1-1 Location of Victoria Field infrastructure

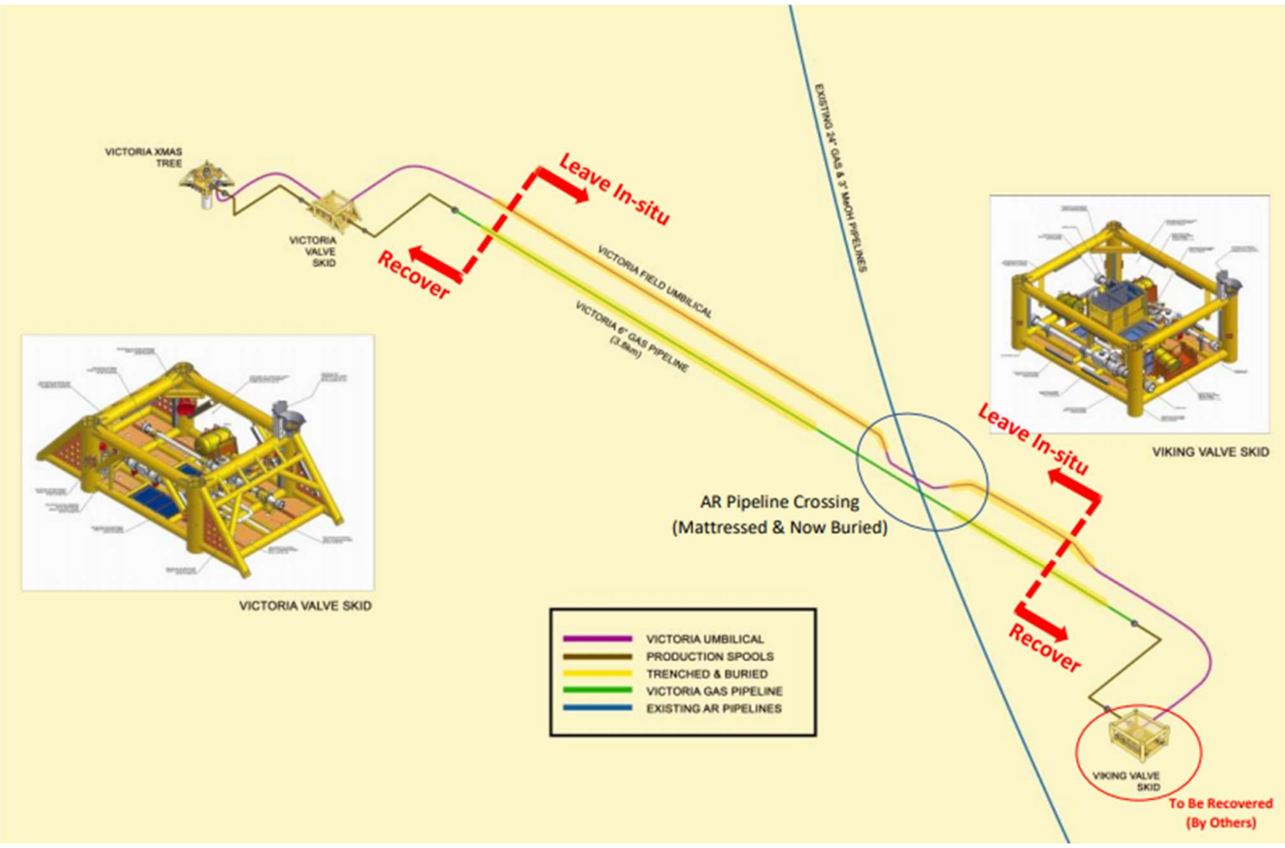


Figure 1-2 The Victoria Field infrastructure for decommissioning

1.3.1 Summary of DP1 infrastructure

The installations consist of the following:

- The Victoria (49/17-14a) wellhead, xmas tree and integrated WHPS.
- The Victoria valve skid
- Concrete mattresses and grout bags.

1.3.2 Summary of DP2 infrastructure

The pipeline and umbilicals consist of:

- Tree to valve skid spool;
- Tree to valve skid controls jumper (27 m);
- Valve skid to main pipeline 6- inch spool (three 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.

With the exception of the physical removal of the Victoria wellhead, xmas tree and integrated WHPS, the activities associated with well plugging and abandonment (P&A) will be subject of a future well intervention application (WIA) via the BEIS Portal Environmental Tracking System (PETS) system. The Viking BD valve skid (Figure 1-2) is being decommissioned by Harbour Energy and is therefore not part of this scope.

1.3.3 Proposed decommissioning approach

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 length of production pipeline and 144 m length of umbilical at the Viking AR crossing, as well as associated stabilisation materials will be decommissioned where it is buried, *in situ*.

1.3.4 Alternatives considered

Full removal of the infrastructure associated with DP1 is the preferred alternative in line with Legislation and Guidance (OPRED, 2018). For DP2, pipeline, umbilical and protective materials, a Comparative Assessment (CA) was undertaken to select the best decommissioning options. The outcome from the CA options is discussed in Section 2.4.

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.
Inspection regime	Project impacts will be monitored during the decommissioning activities and following cessation of any operations to verify that impact predictions are consistent with the subsequent outcomes. An ongoing inspection regime will be determined following decommissioning close-out and will be decided in conjunction with OPRED.

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.

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 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. This letter was sent to the following stakeholders:

- 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 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 against the conservation objectives of these SACs.	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 against a risk matrix.	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 full inventory for the pipeline and umbilical and provides an assessment of the impacts of this release in the associated OPEP (Fraser Well Management, 2020). Oil Pollution Prevention and Control (OPPC) permit will be applied for any discharges to sea and a full Chemical Risk Assessment (CRA) will be carried out.	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.	A pipeline and umbilical ROV survey was carried out by Fugro in April 2021 that included both a General Visual Inspection (GVI) and a Depth of Burial (DoB) assessment. In summary, the survey results showed that (with the exception of the AR pipeline crossing) the Victoria pipeline and umbilical remain trenched below seabed level throughout their lengths with generally good (circa 1.4 m cover) being maintained. The survey was also compared to previous surveys which indicated that the assets have remained mostly buried over a 13-year period and in most instances, an increase in the depth of burial over this time. There was no evidence of free spanning although there were a few exposures and a few of the block segments within some of the concrete protection mattresses could be seen at the AR pipeline crossing. Remediation for these areas is discussed in this EA and will be applied during decommissioning activities, where deemed necessary to mitigate snagging risk. On the basis of the above, NEO has a clear picture of the current burial status of the pipeline and umbilical and there is no plan to perform any other survey work prior to commencement of the decommissioning works in 2022.	7
	BEIS noted that in an area of scientific interest and conservation sites, JNCC is questioning internally the need for an overtrawl study post decommissioning. The overtrawl works causes disturbance of the seabed over a large area and as an alternative debris and crossings could be inspected via non-intrusive means. BEIS would want confirmation that safety issues are captured in another way (i.e. by visual means, recorded).	NEO with guidance from BEIS, JNCC and NFFO will propose alternative, remote clear seabed survey method.	2 & 5

Consultee	Summary of issues raised	NEO'S response	EA section
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 is planning to remove all their structures from the seabed, these being the Victoria tree and its integrated protection structure, the Victoria Valve Skid and all tie-in spools and wellhead control jumpers together with their associated protection mattresses. This will leave only the pipeline and umbilical in-situ, both of which mostly remain buried to a typical depth of around 1.4 m, outwith the crossing of the AR pipelines and with the exception of some exposed sections which will be removed. At the crossing location the pipeline and umbilical are protected by concrete mattresses which themselves have become buried over time. On this basis, a clear and fully over-trawlable seabed with no surface obstructions will be left post decommissioning and confirmed as such by an "as left" visual site survey. However, it is recognised that future status monitoring / inspections will be carried as agreed with OPRED and based on appropriate risk assessment. In addition, key information on field status will be issued to the fishing industry via the Kingfisher protocol and in the form of an update to the FishSAFE dataset.	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.

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 6. Discharges to Sea 7. Societal Impact 8. Underwater Noise 9. Accidental Events	Identification of potential sources of impact to environmental and societal receptors, cumulative and transboundary impacts, and details of practicable mitigation strategies.
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: Pipeline Burial Status	A summary of pipeline burial studies and the latest burial status
Appendix C: Energy & Emissions	A summary of conversion factors and assumptions used in the energy and emissions analysis.

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 activities. 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. Given the scale and number of activities planned to occur within the SNS in the forthcoming years, cumulative effects that have the potential to result in an adverse effect on SAC integrity and therefore the specific conservation objectives for that SAC will also be considered.

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.

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) consists of:

- The Victoria wellhead and xmas tree, complete with integrated WHPS;
- Victoria valve skid;
- 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;
- 150 concrete mattresses distributed between the Victoria well location (60-off), at the pipeline crossing of Viking BD to AR pipeline (45-off), and at the Viking BD skid location adjacent to the Viking BD platform (45-off);
- 13 frond mattresses surrounding the Victoria well head; and
- An estimated 242 grout bags (weighing 25 kg) 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 and Figure 2-1 and Figure 2-2 provide an overview of the infrastructure placement at the Victoria and Viking pipeline ends, respectively.

Table 2-1 - Key infrastructure coordinates

Infrastructure	Coordinates				Distance from well (m)
	Eastings	Northing	Latitude	Longitude	
Well Centre (wellhead and integrated WHPS)	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
Viking BD Valve Skid*	455753.16	5922383.52	53°26' 50.895" N	2°20' 01.407" E	3,660

*To be decommissioned by Harbour Energy

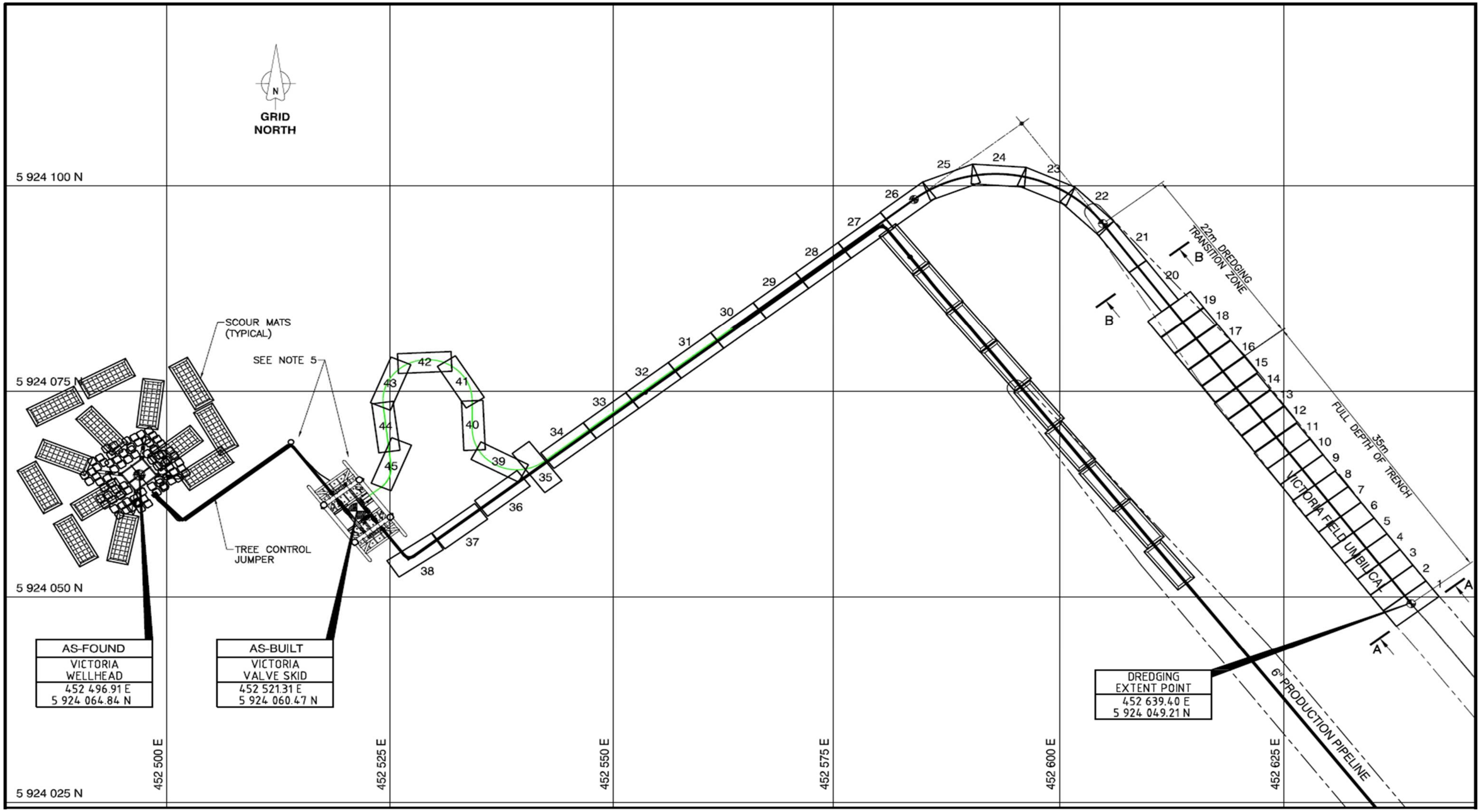


Figure 2-1 - Overview of Victoria subsea infrastructure adjacent to the Victoria skid

Note: For clarity, the 6-off concrete protection mattresses protecting the tree to valve skid tie-in spool and control jumper are not shown.

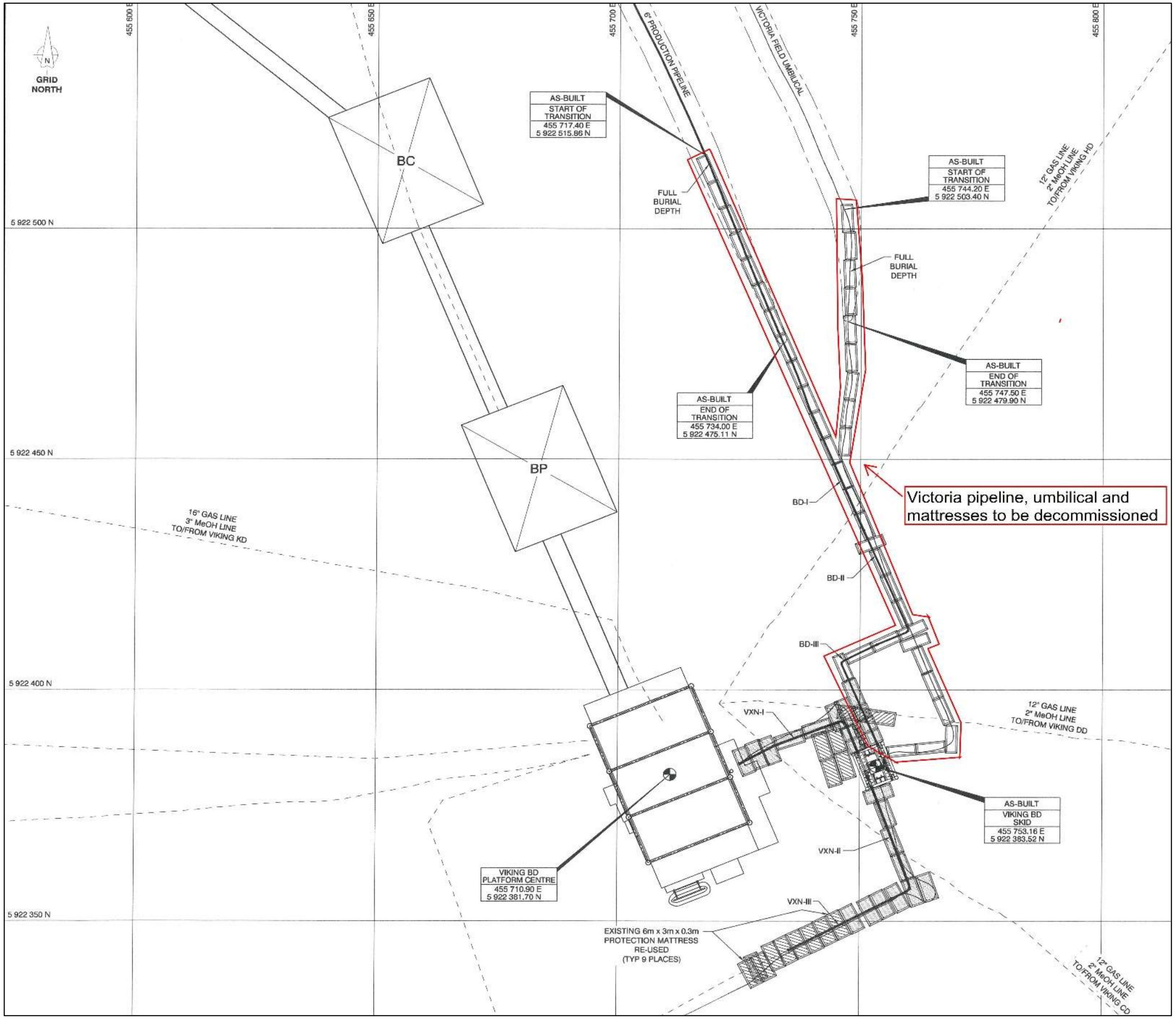


Figure 2-2 - Overview of Victoria subsea infrastructure adjacent to the Viking BD skid

2.2 Decommissioning of Victoria Field Installations

The subsea structures 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 Harbour Energy decommissioning programme and is therefore not covered here.

2.2.1 The Victoria wellhead and WHPS

The Victoria tree is a 5,000 psi Vetco horizontal tree with a fishing friendly integrated WHPS (Figure 2-3). The structure weighs approximately 45 tonnes. It has a footprint of 5.8 m by 5.8 m and the height is approximately 3.5 m upwards of the wellhead centre. The legs of the structure are retractable and are therefore not piled to the seabed. Decommissioning of the well, tree and protection structure will be performed by the well contractors, Fraser Well Management. The removal of the integrated tree and WHPS (including placement of the jack-up rig onto which it will be lifted) will be considered as part of the decommissioning scope. 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). The remainder of the P&A scope (e.g. chemical use and discharges associated with well abandonment) will be assessed on WIA and marine license submissions via PETS.

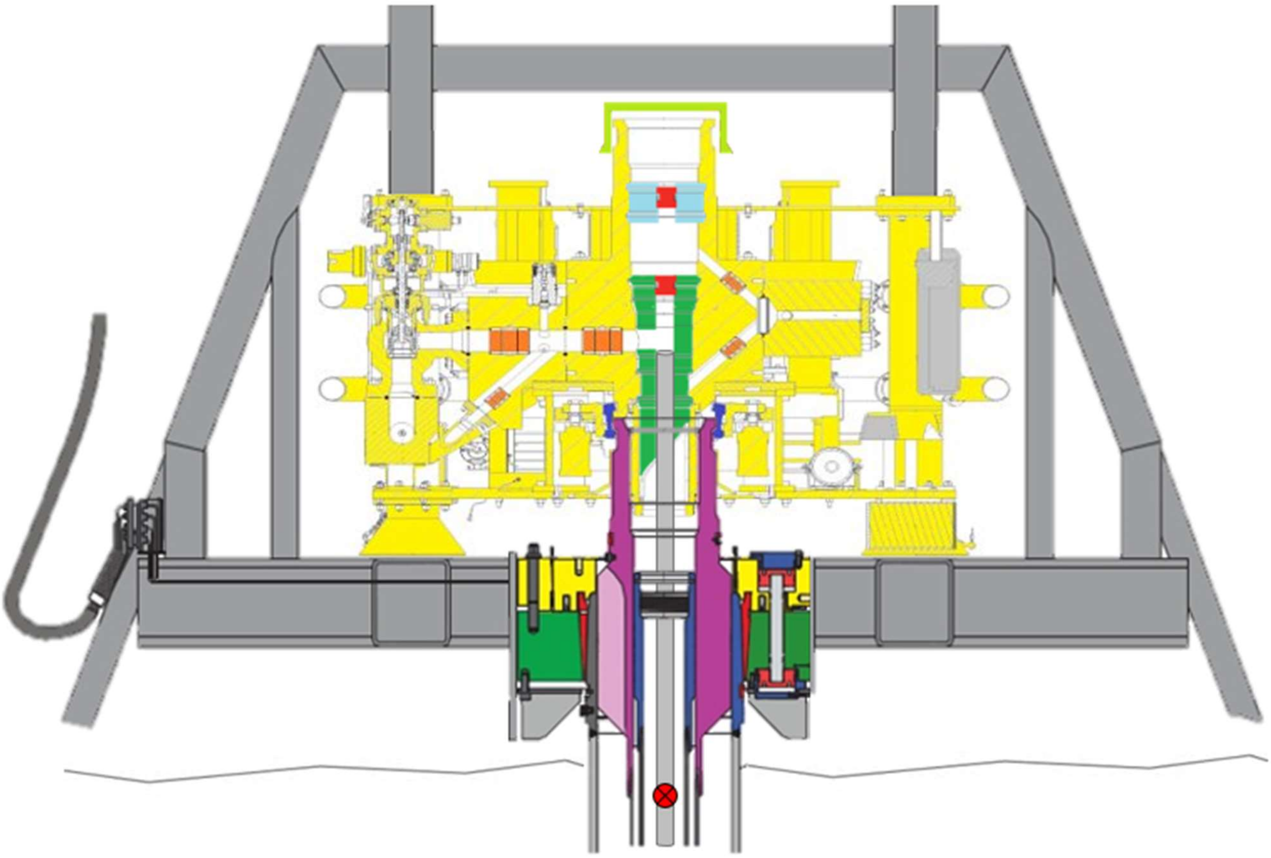


Figure 2-3 The Victoria wellhead and integrated WHPS

2.2.2 Victoria Valve Skid Structure

The Victoria valve skid (Figure 2-4), 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) and weigh approximately nine tonnes. 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) via internal cutting.

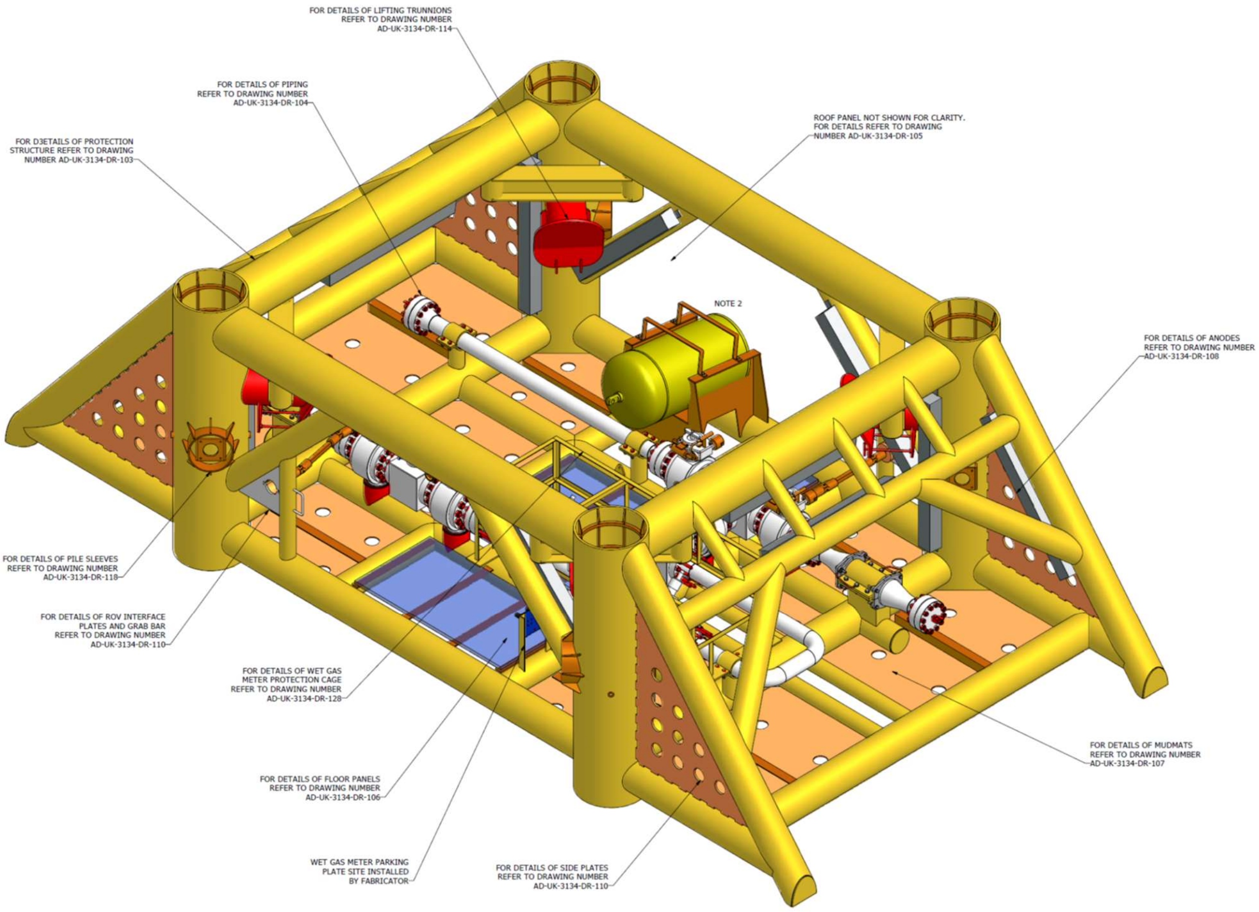


Figure 2-4 - Victoria Valve Skid (roof panel not shown). Source: NEO Energy.

2.2.3 Concrete Mattresses & Grout Bags

In total there are 60 plain concrete and 13 fronded anti-scour mattresses at the Victoria well. The plain mattresses are 6 m x 2.4 m x 0.15 m in size, weighing four tonnes each in air. At the Viking end of the pipeline there are 45 plain concrete mattresses. These mattresses are either 6 m x 2.4 m x 0.3 m or 6 m x 3 m x 0.3 m. At the AR crossing there are a further 45 mattresses which are variably 6 m x 2.4 m x 0.15 m or 6 m x 3 m x 0.3 m (Appendix B). 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. While the exact location of grout bags in the Victoria field is not known, 242 grout bags (each weighing 25 kg) were accounted for in the field ‘as-built’ reports and drawings. These will have been placed in the field in 1 Te bags, wherein each back contains 40 individual grout bags. Of the 242 grout bags, 105 grout bags were placed at the Victoria well while the remaining bags were deployed elsewhere. While the dimensions of the grout bags are not known, it is assumed they are of a standard size of approximately 0.6 m x 0.3. In line with standard practice, it is believed the grout bags are made from a polypropylene material filled with a mix of sand and cement. As with mattresses, the intention is to remove these grout bags where safe to do so.

Mattresses and grout bags in relation to the Viking BD Platform and skid are the responsibility of Harbour Energy and are not included here.

2.3 Decommissioning of Pipeline & Umbilical

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.

2.3.1 Victoria Field Pipeline (PL2526)

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 is trenched and buried (BMT Cordah, 2018a; Appendix B). The pipeline crosses the Viking AR 24” and 3” lines within the Harbour Energy Viking 500 m safety zone, near to the BD skid. Outwith the tie-in spools, trench transitions and the AR pipeline crossing, the Victoria pipeline remains mostly buried throughout its length with cover depths generally exceeding 1.4 m. While there are 17 areas of ‘exposure’ along the pipeline, these are in fact mattress exposures, indicating a level of reburial and are located within the initial 106 m of the pipeline and are therefore associated with spools and the trench transition all of which are to be removed. The exposures identified elsewhere are limited to the top of the pipe and as such no spanning is evident (Appendix B). However, to prevent future exposure or free-span due to sandwave migration, two midline sections of pipeline and umbilical will be removed as mitigation against snagging. Depth of Burial (DoB) profiles are available in Appendix B.

The lengths of spools for the Victoria development are approximately 177 m. They are split as follows:

- Victoria tree to Victoria valve skid (approximately 27 m);
- Victoria valve skid to production pipeline, split into two sections (approximately 72 m); and
- Production pipeline to Viking BD skid, split into three sections (approximately 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 production pipeline was depressurised at CoP in 2016 and reduced to 1 bar. It was subsequently re-pressurised, and the last recorded pipeline pressure following re-pressurisation and disconnection was approximately 5 bar. As the pipeline has been shut in and connected to the Victoria well since 2016, NEO will assume the worst case scenario i.e. that valves may have passed and that the pipeline may have re-pressurised to current well head shut in pressure of 30 bar and full de-pressurisation will be managed accordingly.

The as-left condensate contents are estimated to be between 0 and 0.6 m^3. This estimate considers 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 (Verus Petroleum, 2018b).

2.3.2 Victoria Field Control Umbilical (PLU2527)

A 3.95 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 5.

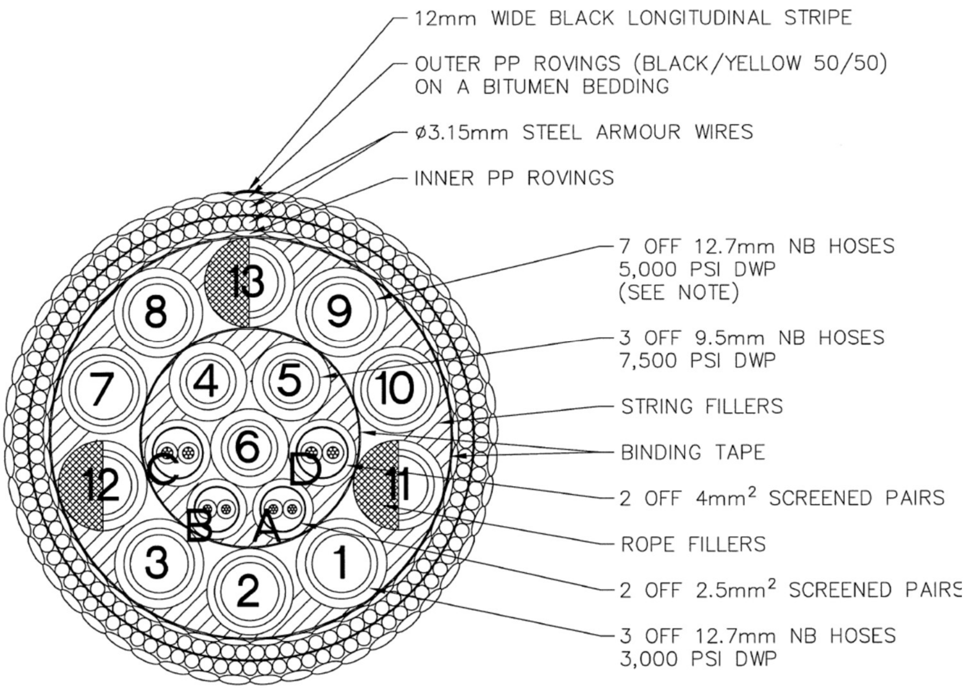


Figure 2-5 - Control and chemical injection umbilical cross section

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)

2.4 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) used to identify the best option for pipeline decommissioning and pipeline flushing.

2.4.1 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, remove and recover pipeline, reel umbilical back on vessel);
- Option P2a - partial removal of the seabed infrastructure (cut and remove and recover pipeline ends plus midline and AR pipeline crossing sections, reel back umbilical);
- Option P2b - partial removal of the seabed infrastructure (cut and remove and recover pipeline ends plus midline pipeline sections, reel back umbilical);
- Option P3a - leave in situ (cut, remove and recover only pipeline / umbilical ends and midline sections);
- Option P3b – leave in situ (cut, remove and recover only pipeline / umbilical ends, midline sections and AR pipeline crossing section).

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 and exposures with minimal remediation, 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 all mattresses and exposed grout bags with the exception of those mattresses (45) and grout bags installed at the AR crossing and those mattresses (15) and grout bags installed at the start of the trenched section of the umbilical (Victoria end) where the umbilical is known to be at full trench depth. Where appropriate, NEO will remediate using jetting methods at any exposed cut ends and sections.

The pipeline crossing between Harbour Energy 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. Harbour Energy has been granted an approval to leave AR pipeline *in situ*, therefore, NEO proposes to align their option with this approach and decommission crossing *in situ*. Harbour Energy 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.

2.4.2 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 structures will be removed. The majority of the pipeline and umbilical will be decommissioned *in situ*, with only the ends of the pipeline and umbilical and midline exposed sections of the pipeline and umbilical (totalling 480 m), being removed in accordance with the Decommissioning of Offshore Oil and Gas Installations and Pipelines Under the Petroleum Act 1998. Where appropriate, NEO will remediate any exposed cut ends and sections with reburial to >0.6 m depth as the preferred option.

Decommissioning operations will be carried out from a Dive Support Vessel (DSV), with support from a Construction Support Vessel (CSV) if required. The wellhead and integrated WHPS will be recovered to a jack-up rig. For the purposes of covering all scenarios, time has also been accounted for a guard vessel (in the instance that the DSV or CSV has to leave site), a rock vessel, in the instance that rock remediation is required for jack-up rig stabilisation and survey vessels to support any non-intrusive post-decommissioning survey activities.

For the transportation back to shore of all recovered items, plus accommodation of the necessary decommissioning tools, an approximate deck space requirement is shown in Table 2-3. On this basis, a typical sized DSV with circa 1,000 m^2 of deck space should be able to complete the scope 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 wellhead and WHPS*	5.8 x 5.8 m x 3.5 m	33.6
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 Petroleum (2017a)

*To be removed to the drill rig. Remaining structures to be removed to the DSV.

There are a number of options for the removal of the pipeline spools 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 using subsea grab or similar; and
- Cut spools into discrete lengths and recover multiple sections using subsea basket to vessel.

The specified cutting equipment to be utilised for cutting of the wellhead, pipeline ends, the pipeline tie-in spools and the umbilical will typically comprise of either a diamond wire cutter or a subsea shear, with the former option being generally favoured based on ease of handling and a more compact design. However, in terms of environmental impact and the time taken to complete the cutting operation(s) there is little difference between the two methods, especially given the relatively small diameters of the pipe and umbilical.

To facilitate removal of the Victoria valve skid it is the intent to cut each of the four 24" diameter piles 3m below the mudline using an internal rather than an external pipe cutter and thereby avoid having to carry out substantial seabed excavation at the four corner locations. The preference is to make the cuts using abrasive water jet technology and an inert garnet cutting media. Such jet cutters are now routinely used subsea for cutting piles and provide a quick and effective method with little or no impact to the environment.

After extracting the pile pin, an internal clean-out tool complete with dredging pump would first be run to remove the soil infill from within the pile down to just below the 3m cut line. Thereafter, the jet cutter would be deployed with the tool being designed to slide internally down the pile until the rotating nozzle reaches the required depth. Both the clean-out and the jetting tools would be deployed from the vessel crane and operated without the aid of divers. Extraction of the cut pile section could be performed as a separate operation or could coincide with recovery of the cutting tool.

The wellhead will also be cut at 10 ft (3 m) below the seabed using internal rotary cutting techniques following well P&A. The wellhead, xmas tree and integrated (non-piled) WHPS will be lifted to the drill rig once the WHPS legs have been retracted. Any seabed trough remaining shall thereafter rely on natural backfill to provide infill. Given the dynamic nature of the surface sediment in this area of the SNS, NEO deem re-burial to be the most suitable remediation option.

2.4.3 Post-decommissioning Surveys

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).

2.4.3.1 Debris Clearance & Clear Seabed Survey

An as-left seabed site survey will be carried out post-decommissioning centred on the route of the pipeline and umbilical. Any significant seabed debris will be recovered and transported to shore for disposal or recycling in line with existing disposal methods. As agreed with OPRED during pre-submission consultations, due to the sensitive environmental setting (Section 3) this survey will be non-invasive. This will be followed by a statement of clearance to all relevant governmental departments and Non-Governmental Organisations (NGO).

2.4.3.2 Ongoing Inspections & 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 inspections when the Victoria decommissioning activities are concluded. After the initial post-decommissioning site survey reports have been sent to OPRED and reviewed, a post-decommissioning inspection regime will be agreed by both parties.

2.5 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 subsea structures is not considered likely, but the option will be considered.

Recovered infrastructure will be returned to shore and transferred to suitably licensed decommissioning / waste facilities. 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, pipeline ends and spools will be recycled. 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)	Decommissioned *in situ* (tonnes)
Subsea installations	102	102	0
Pipeline	199	33	166
Umbilical	71	9	62
Concrete mattresses	600	360	240
Frond mattresses	52	52	0
Grout bags	6	6**	0
TOTAL	**1,030**	**562**	**468**

*Grout bags will be removed where feasible to do so. Where this is not possible, NEO will refer to OPRED to discuss the technical and/ or safety issues associated with these operations.

2.6 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 within IoP (2000) guidelines (Appendix C). In accordance with these guidelines, alternative factors are 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:

- Vessels for 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 sent to 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. Energy use and atmospheric emissions associated with jack up rig use for well P&A is considered here outside the main scope of the project and has been included here for reference as a cumulative impact.

The total annual CO_2 emissions from offshore oil and gas UKCS operations during 2018 were 13.2 million tonnes. The estimated CO_2 emissions released during the decommissioning of the Victoria infrastructure and flushing operations represent approximately 0.04% of this total (Oil and Gas UK, 2019).

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

Decommissioning aspect	Energy use (GJ)	Approximate contribution (%)
Subsea infrastructure decommissioning and flushing operations		
Vessel use	65,262	91.04
Onshore transportation	28.4	0.04
Recycling	2,099	2.9
New manufacture to replace recyclable materials left *in situ* or landfilled	4,295	6.0
TOTAL	**71,684**	**100**

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 and flushing operations					
Vessel use	4,845	84	6	0	89.8
Onshore transportation	2.05	0.03	0.00	ND	0.04
Recycling	223.9	0.4	0.9	ND	4.1
New manufacture to replace recyclable materials decommissioned *in situ*	325	1	1	1	6.02
TOTAL	**5,396**	**85**	**8**	**2**	**100**

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

2.7 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. Fraser Well Management is the appointed well operator and as such are responsible for the planning and execution of the well P&A scope.

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.

The Victoria subsea decommissioning campaign is scheduled to occur between June and July 2022, followed by a P&A campaign in August 2022. The aim being to submit a close-out report to OPRED by the end of Q4 2022 (6). Should the project be delayed, the same schedule will be followed in 2023, with close-out report submission expected by the end of Q4 2023.

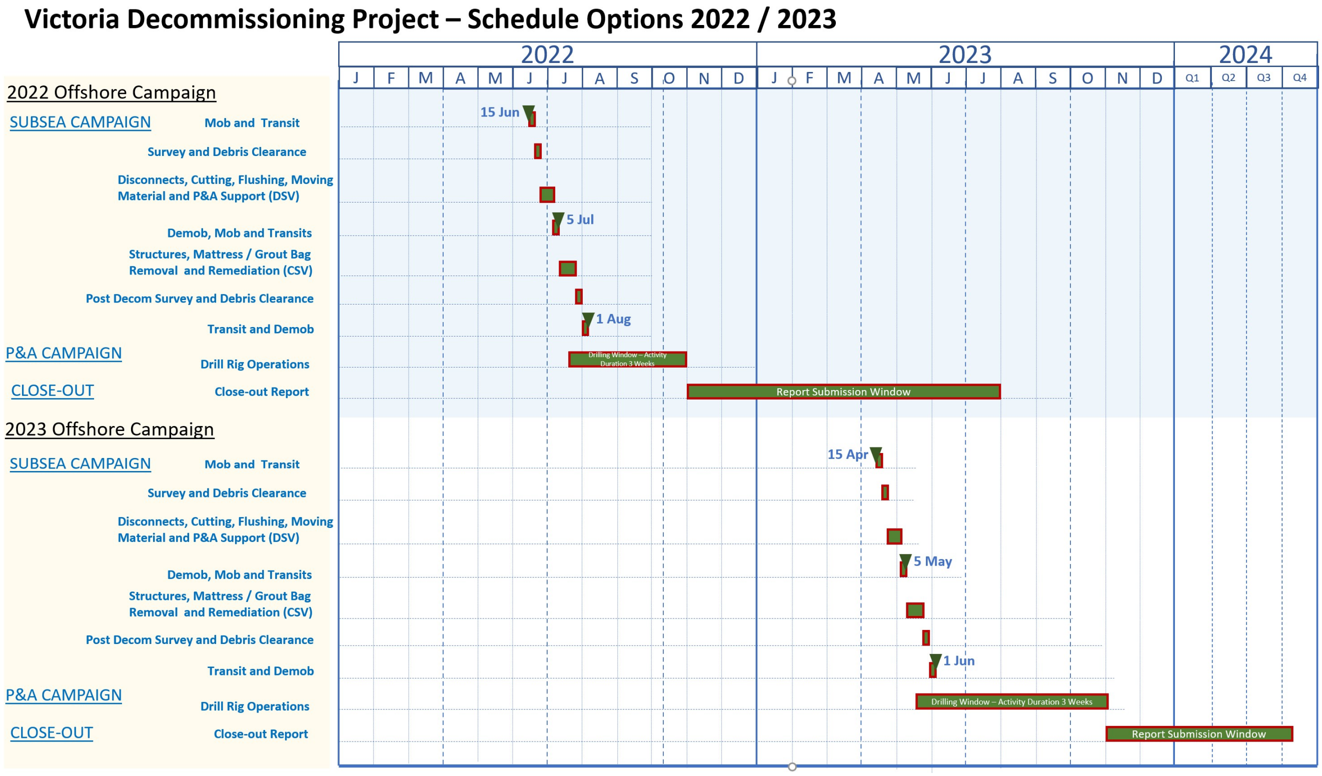


Figure 2-6 - The anticipated decommissioning schedule

Note: The above dates are provisional and the 2022 schedule is subject to vessel availability. In the event that there is no vessel availability to execute the scope in 2022, the work will be rescheduled to 2023 with close-out report submission expected by the end of Q4 2023.

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 49/17 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).

Survey data collected for adjacent ConocoPhillips assets Vulcan UR, Viscount VO, Vampire/ Valkyrie OD in the LOGGS Field and Viking AR, CD, DD, ED, GD and HD in the Viking Field served as basis of information for the Victoria Field assessment (ConocoPhillips, 2015 and ConocoPhillips, 2018). Additionally, ConocoPhillips' report for Viking pipeline replacement between Viking BP and LOGGS PR platform (ConocoPhillips, 2008) provided further detail for the area of interest. The results from Viking AR, CD, ED and GD, located within 2.5 to 9.3 km from Victoria infrastructure (Figure 3-1), are the most relevant to this project and are presented throughout this EA.

From the adjacent surveys (ConocoPhillips, 2015; ConocoPhillips, 2018), sampling points closest to the Victoria infrastructure have been identified as reference points for the baseline survey and future post decommissioning assessments. Those points in relation to the Victoria pipeline are identified in Figure 3-1 and in Table 3-1.

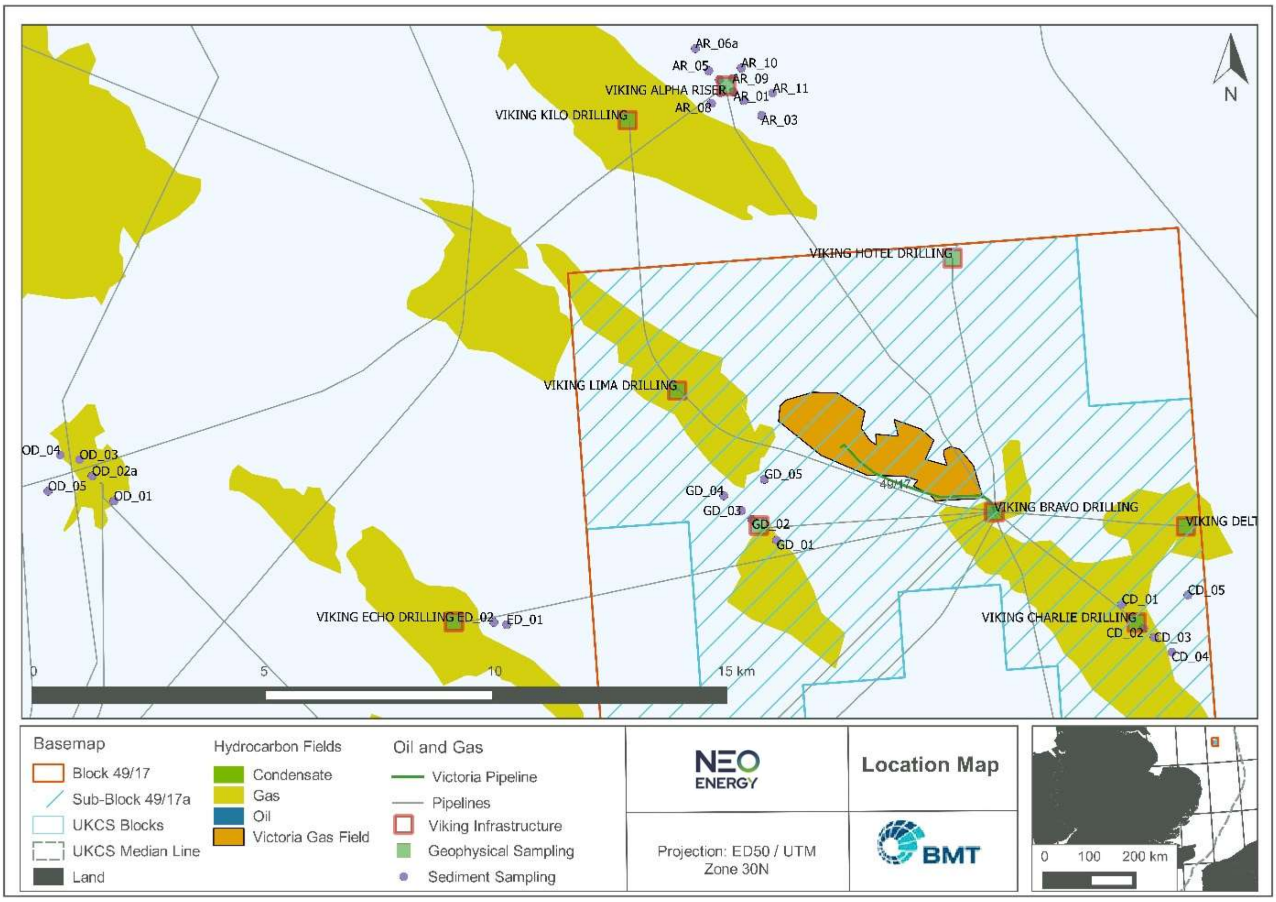


Figure 3-1 - Location of sample stations in the vicinity of Victoria subsea infrastructure

Table 3-1 Location of relevant infrastructure and the closest sediment sampling points (reference points) to Victoria infrastructure

Infrastructure	Distance and direction from Victoria infrastructure*	ID of sampling station closest to Victoria infrastructure*	Distance of sampling station to Victoria infrastructure*
Viking AR	8.2 km N	AR_03	7.3 km
Viking GD	2.5 km SW	GD_05	1.8 km
Viking ED	9.3 km SW	ED_01	8.2 km
Viking CD	3.8 km SE	CD_01	3.4 km

*Distance measured to the nearest point on Victoria pipeline

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).

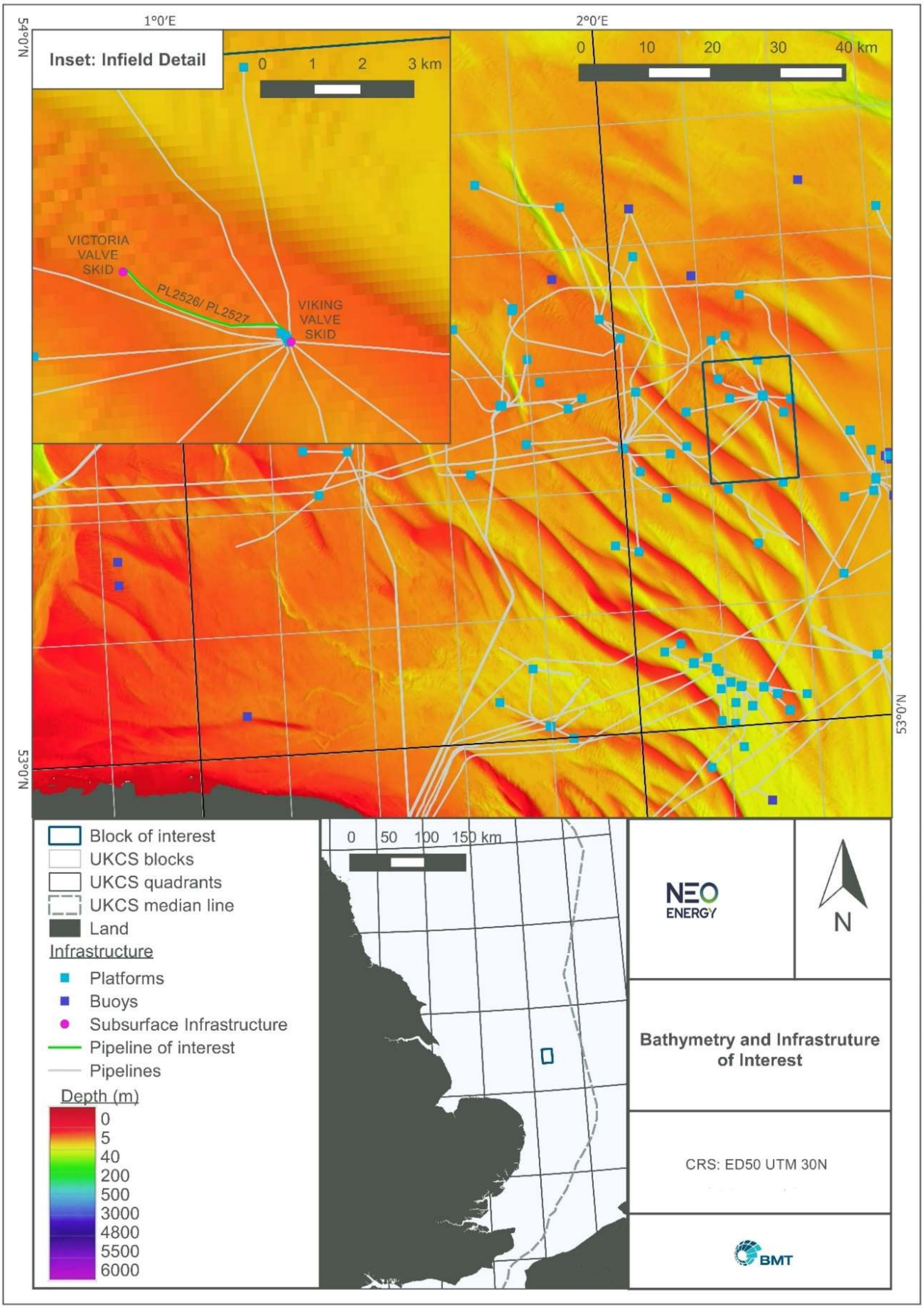
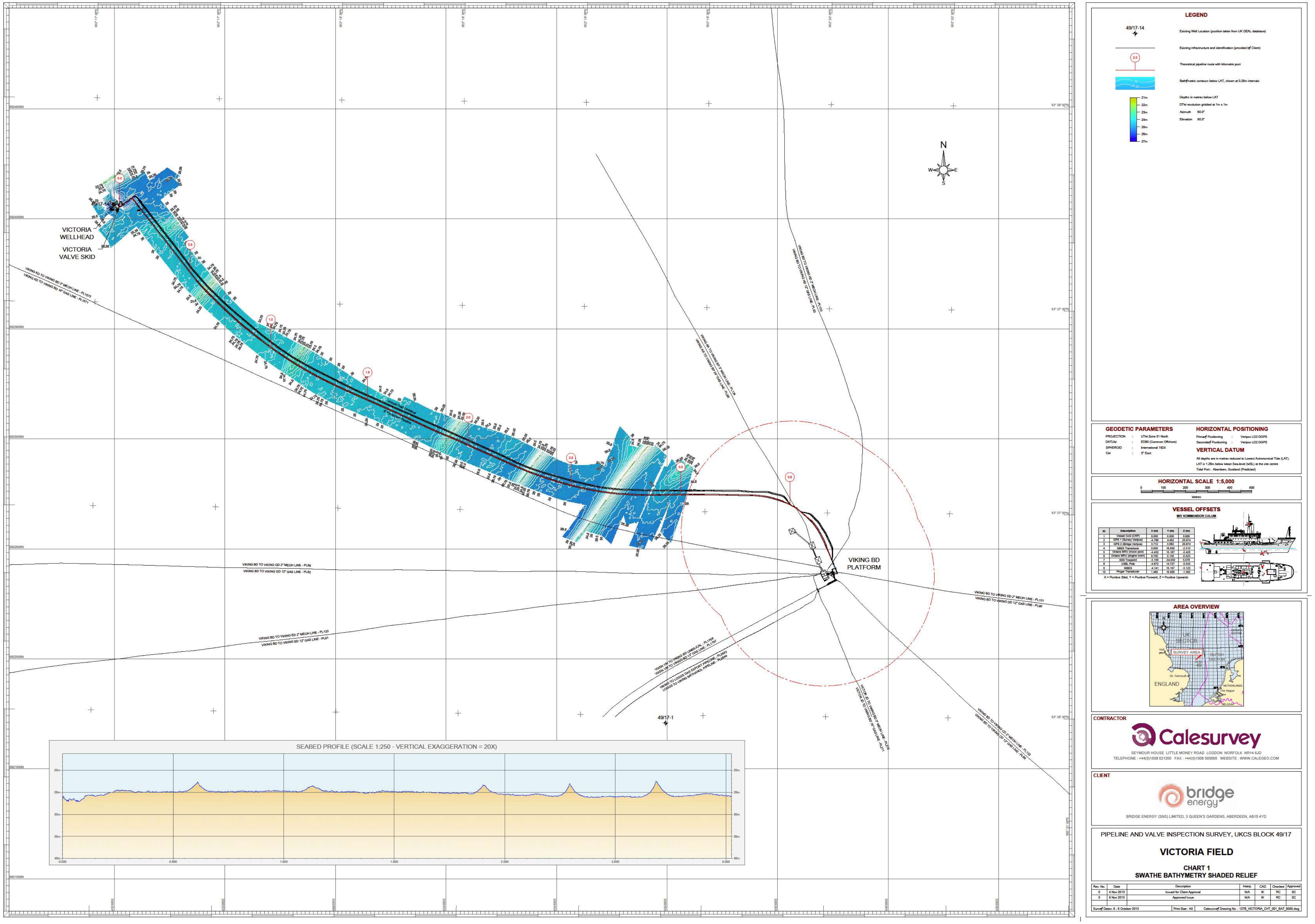


Figure 3-2 - Bathymetry of the area surrounding the Victoria subsea infrastructure



Source: Bridge Energy (2013)

Figure 3-3 - Swathe bathymetry shaded relief

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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 energy and emissions is provided in Section 2.6.

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 results from the surveys conducted around Viking platforms, provide an indication of sediments in the area surrounding Victoria infrastructure (ConocoPhillips, 2015; ConocoPhillips, 2018). Data were consistent across the sampling area. On the basis of the surveys, sediments were classified as very poorly to moderately well sorted, fine sand to fine gravel, with low content of silt/ clay and organic matter (ConocoPhillips, 2018). The highly dynamic marine environment of this part of the North Sea restricts silt and clay content to no more than 15% (ConocoPhillips, 2018).

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 recorded at stations surrounding Victoria infrastructure, are lower than the average background concentrations (Table 3-2) 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) with the exception of AR-05 station near Viking AR platform (ConocoPhillips, 2015, 2018).

The concentrations of metals in the sediments across wider area surrounding Victoria infrastructure were relatively constant, with the exception of one sampling station at Viking GD platform location (located approximately 2.5 km southwest of Victoria infrastructure), where elevated levels of several metals (arsenic, barium, lead, vanadium, copper and zinc) were detected in comparison to other GD samples (Table 3-2). Those elevated values could be related to previous drilling activities, although, no obvious cuttings piles were identified during surveys at this location (ConocoPhillips, 2018).

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).

Table 3-2 - Specific chemistry information from sediment grabs from offshore platform locations around Victoria infrastructure

Reference	THC	As	Cr	Ni	Cu	Zn	Cd	Hg	Ba	Pb
Central North Sea (µgg-1 dry weight) (Min – Max range)										
Offshore (CEFAS, 2001)	17-120	-	-	9.5	3.96	20.87	0.43	0.16	-	-
Oil and Gas Installations (CEFAS, 2001)	10-450	-	-	17.79	17.45	129.74	0.85	0.36	-	-
Background Concentration (UKOOA, 2001)	9.41 (40.10)	-	9.1 (31)	11.46 (21.75)	6.32 (18.00)	21.58 (43.40)	0.76 (1.00)	0.76 (1.00)	348.47 (720.00)	-
Background Concentration (OSPAR, 2005)	-	15	60-81	30-36	20	90	0.2	0.06	-	-
Effects Range – Low (ERL)	-	-	81	-	34	150	1.20	0.15	-	47
Vicinity of Victoria infrastructure										
Viking AR (Block 49/12)	0.6-2.8	10.2-15.9	4.01-5.90	2.89-5.48	0.83-4.85	10.4-58.7	0.01	<0.02-0.12	4.79-54.3	4.13-8.84
Viking CD (Block 49/17)	0.5-2.0	11.13-15.9	4.33-5.03	2.28-2.91	0.57-0.91	8.87-10	0.01	<0.02	2.49-4.83	3.44-4.15
Viking GD (Block 49/17)	0.5-3.3	14.1-32.3	3.64-4.62	1.97-2.71	0.46-2.31	7.33-20.2	0.01	<0.02	3.17-10.8	3.39-6.55
Vampire/ Valkyrie OD (Block 49/16)	2.1-5.5	14-43.2	3.88-6.23	2.20-4.23	0.77-1.92	9.43-20	0.01-0.02	<0.02	3.31-5.46	3.42-7.78
Notes:	(-) means no data currently available									
	UKOOA (2001) values are mean with the 95th percentile shown in parenthesis									

Source: ConocoPhillips, 2018; CEFAS, 2001; UKOOA, 2001; OSPAR, 2005

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 49/17 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). Photos taken during surveys near Victoria are shown in Figure 3-4 the images correspond to the sample locations which are closest to Victoria (Table 3-2). Survey effort is shown in Figure 3-1.

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.

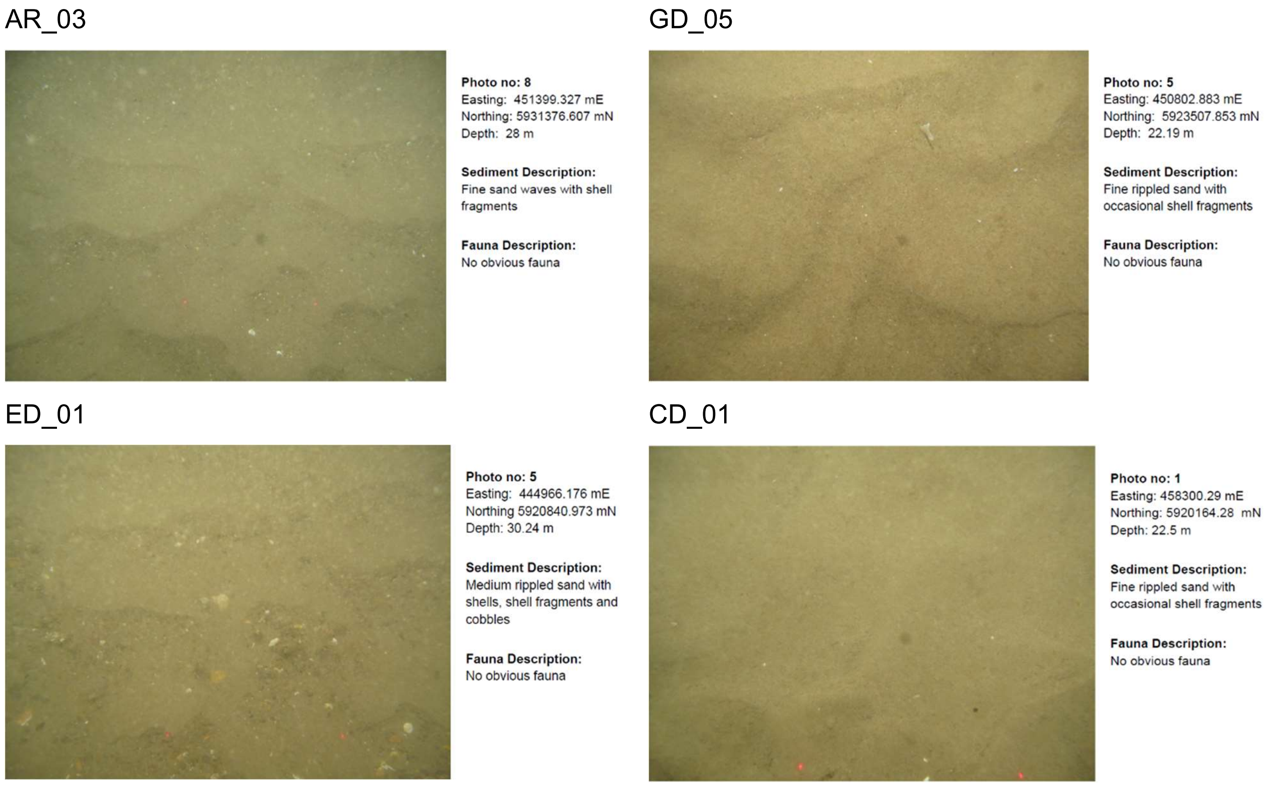

Figure 3-4 Photographs of the seabed environment from surveys around Victoria

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 a number of species. The following are likely to utilise the immediate area around Victoria as spawning grounds: 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), 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) (Figure 3-5 and Figure 3-6). 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.

There are five species of sandeels known to occur in the North Sea, with the majority (90%) of the commercial catch made up of the lesser sandeel Ammodytes marinus. They are restricted to sandy sediments (Holland *et al*., Mazik, *et al*., 2015, 2005; DECC, 2016). Sandeels usually spawn between November and February and lay eggs in clumps on sandy substrates (DECC, 2016). The larvae are pelagic for approximately two to five months after hatching and are believed to over-winter buried in the sand (DECC, 2016). Sandeels are important not only to commercial fisheries but also are of ecological significance as they are a vital food source for marine birds and predatory fish (DECC, 2016). As a prey species which supports the harbour porpoise population, the preservation of sandeel habitat is a conservation objective of the Southern North Sea SAC.

The Victoria subsea infrastructure also lies within the nursery grounds for cod, herring (*Clupea harengus*), horse mackerel (*Trachurus trachurus*), lemon sole, mackerel, *Nephrops*, plaice, sole, sprat, tope shark (*Galeorhinus galeus*) and whiting (Aires *et al*, 2014; Ellis *et al*., 2010; Coull, *et al*., 1998) (Figure 3-7 to Figure 3-9). 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 Figure 3-7 to Figure 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.

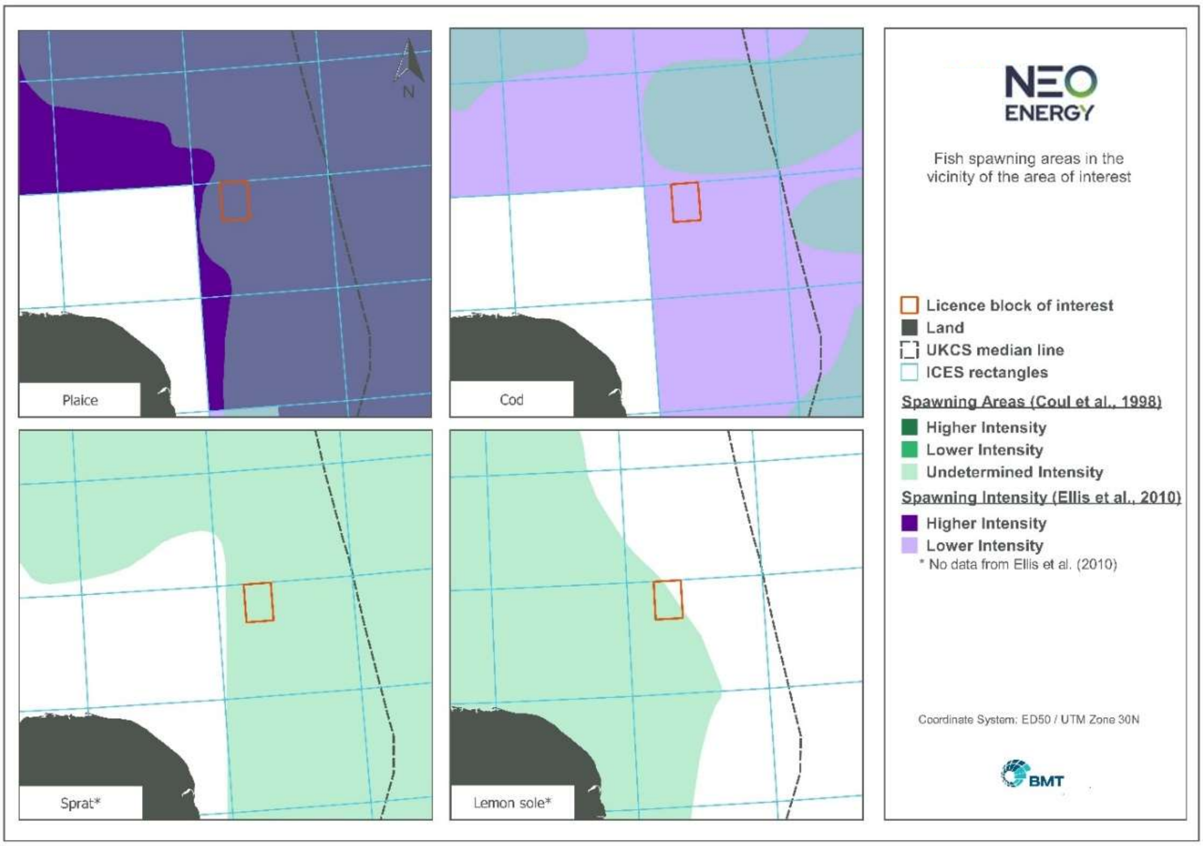

Figure 3-5 Fish spawning areas in the vicinity of the Victoria infrastructure ½

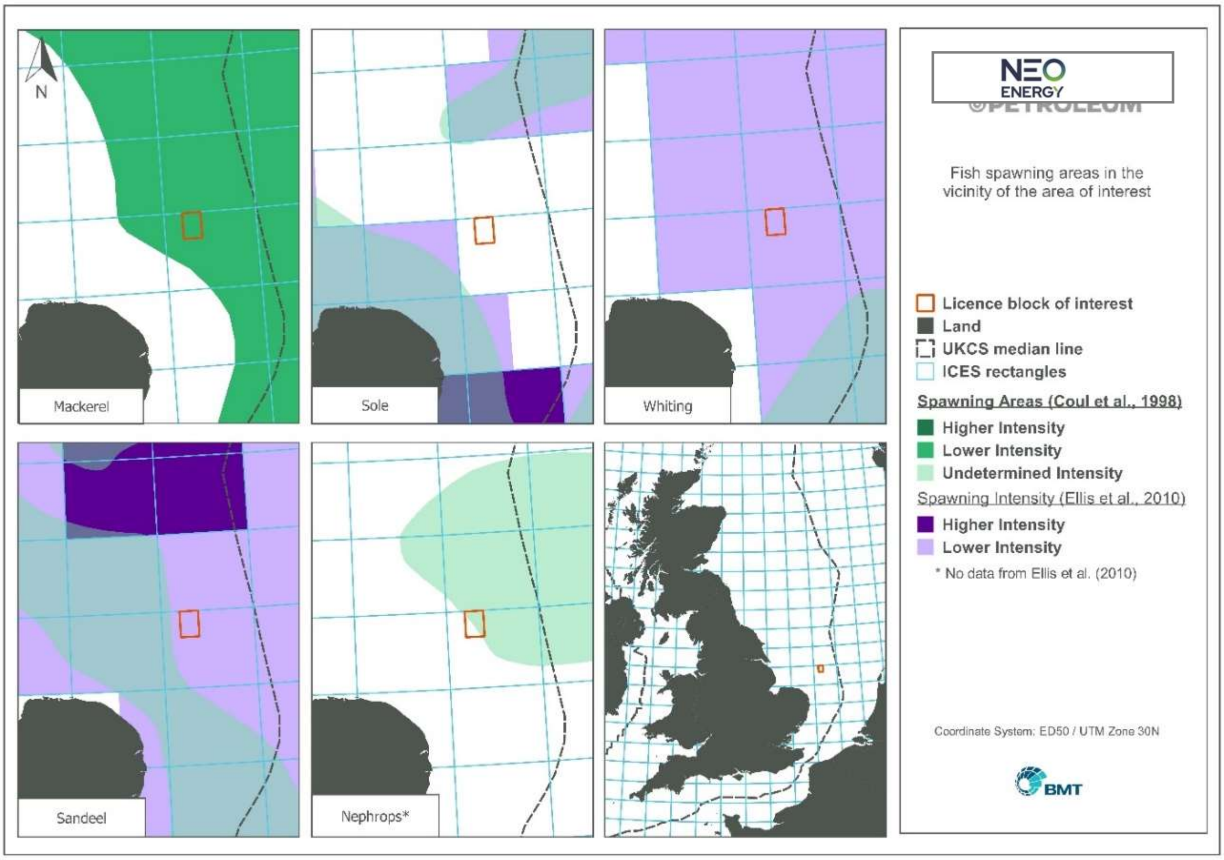

Figure 3-6 - Fish spawning areas in the vicinity of the Victoria infrastructure 2/2

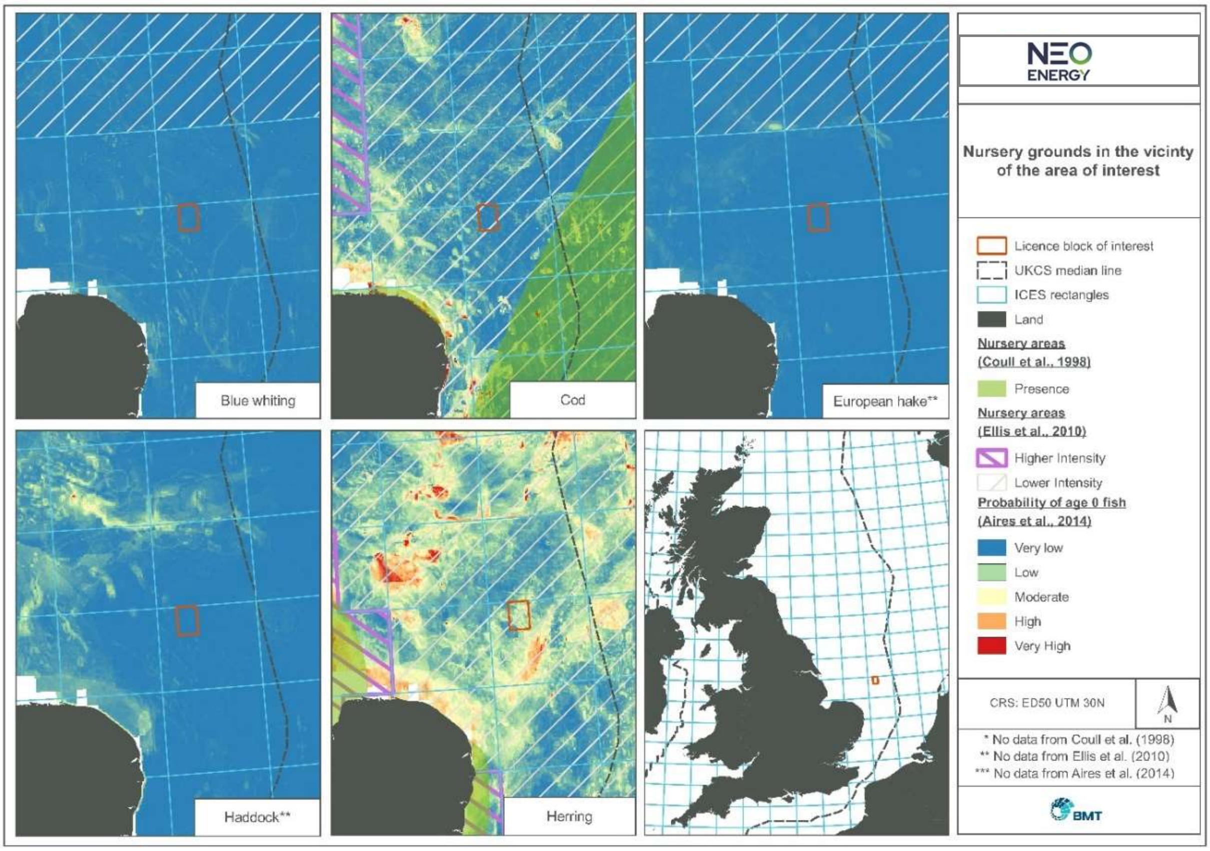

Figure 3-7 - Nursery grounds in the vicinity of the Victoria infrastructure 1/3

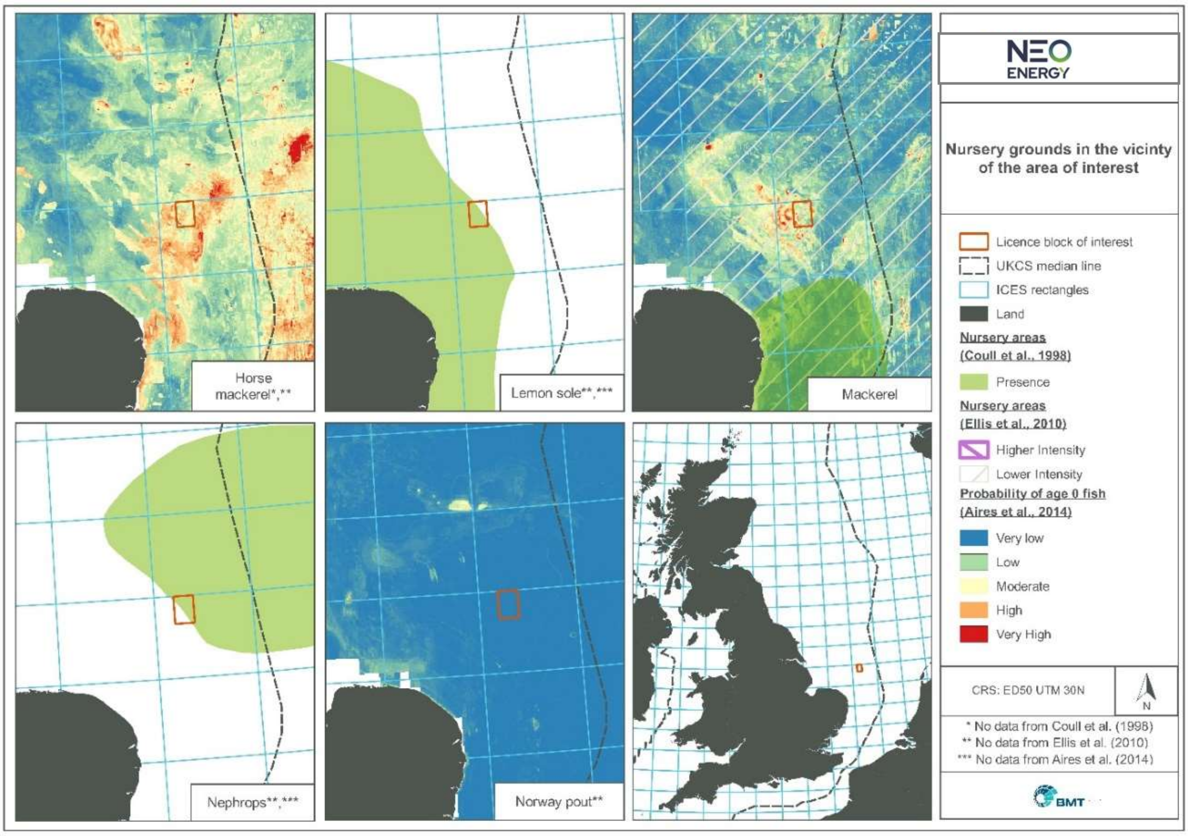

Figure 3-8 - Nursery grounds in the vicinity of the Victoria infrastructure 2/3

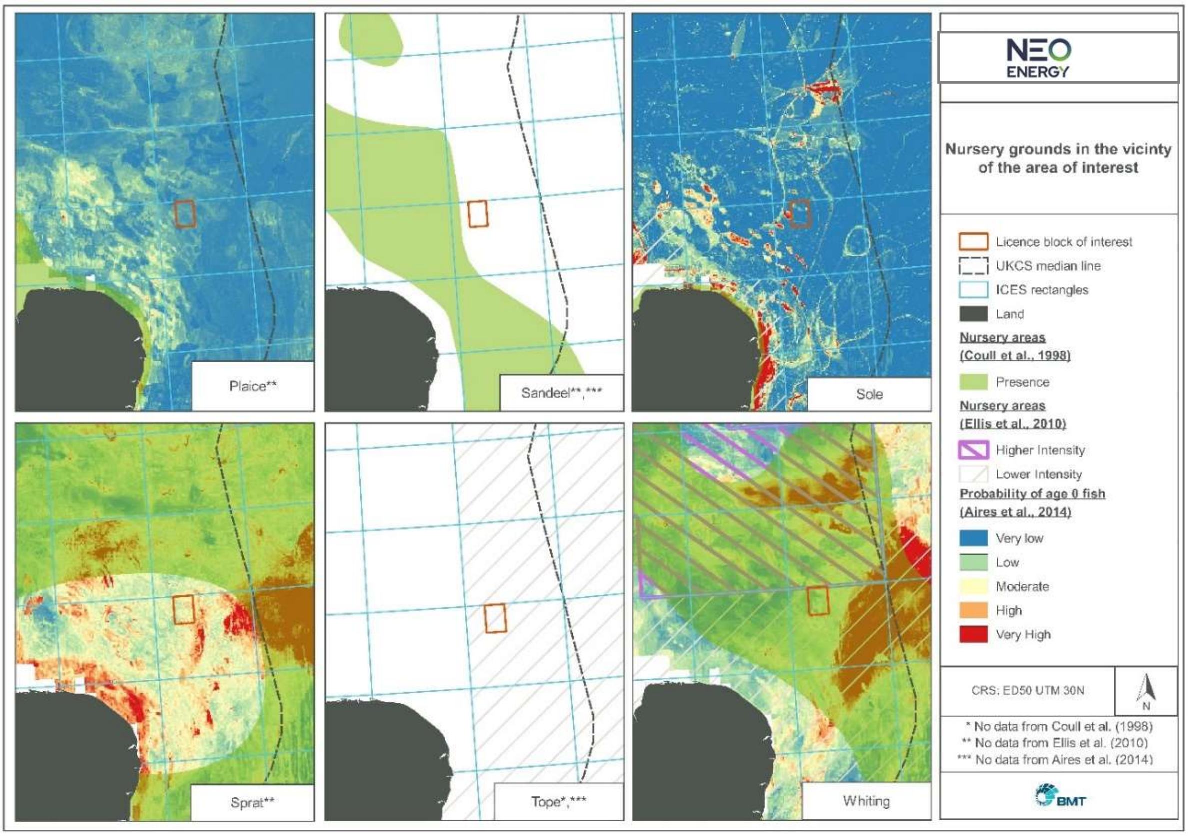

Figure 3-9 - Nursery grounds in the vicinity of the Victoria infrastructure 3/3

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).

Kober *et al*. (2010) analysed European Seabirds at Sea (ESAS) density data for seabirds within the British Fishery Limit to identify ‘hotspots,’ with a view to assigning these areas marine a SPA status (Section 3.3.2 provides more detail on SPA designation). Several hotspots for seabirds have been identified around UK, however, none of these overlap with the Victoria area. Based on those data seabirds density surface maps were developed. The maps were generated using Poisson kriging, a special interpolation technique, to generate continues density surface maps for 32 species and seabirds’ assemblages. Table 3-3 presents predicted maximum monthly density of seabirds in the Victoria area (Kober *et al*., 2010).

Table 3-3 - Predicted monthly surface density of seabirds in the Victoria area

	Month												
Species	**Season**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Fulmar	breeding			D	D	D	D	D					
	winter	C	C						C	C	C	C	C
European storm petrel	breeding						A	A	A	A	A		
Gannet	breeding					B	B	B	B	B			
	winter	B	B	B	B						B	B	B
Pomarine skua	additional								A	A	A	A	
Black-legged kittiwake	breeding					B	B	B	B	B			
	winter	B	B	B	B						B	B	B

	Month												
Species	**Season**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Great black-backed gull	winter	A	A	A						A	A	A	A
Common gull	breeding					A	A	A	A				
	winter	A	A	A	A					A	A	A	A
Lesser black-backed gull	breeding					A	A	A	A				
	winter	B	B	B	B					B	B	B	B
Herring gull	winter	A	A	A						A	A	A	A
Common guillemot	breeding					B	B						
	additional								B	B			
	winter	B	B	B	B						B	B	B
Razorbill	breeding					A	A						
	winter	B	B	B	B						B	B	B
Atlantic puffin	winter	A	A	A					A	A	A	A	A

KEY		A	B	C	D
Seabirds density (numbers per km^2)	Not recorded	<1.0	1.0 - 5.0	5.1 – 10.0	10.1 – 20.0

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, June, July and December, with very high sensitivity within Block 49/17 in December and February (Table 3-4).

Table 3-4 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*	N	N	1*	1	5	5*	N	N	1*
49/12	N	1*	N	N	5*	5	1	5	5	5*	N	1*
49/13	5*	N	N	N	5*	5	2	5	5	5*	5*	5
49/16	2*	2	2*	N	N	5*	5*	5	5*	N	2*	1*
49/17	N	1*	2*	N	N	2*	2	5	5	5*	N	1*
49/18	5*	N	3*	N	5*	5	2	5	5	5*	5*	5
49/21	1*	1	2	2*	N	N	5*	5	5*	N	1*	1
49/22	1*	3*	3	3*	N	5*	5*	5	3	3*	1*	1
49/23	3*	4*	4	4*	5*	5	5*	5	5	5*	3*	3
Key	1 = Extremely high		2 = Very high		3 = High		4 = Medium		5 = Low		N = No data	

* in light of coverage gaps, an indirect assessment of SOSI has been made using the method provided by the JNCC (Webb *et al*., 2016)

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 3-5).

Table 3-5 - Cetacean 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	(green)	Sightings within Quadrant 49
	L	Low densities	VH	Very high densities	(blue)	Sightings in surrounding Quadrants
	M	Moderate densities				

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 3-10).

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 3-10).

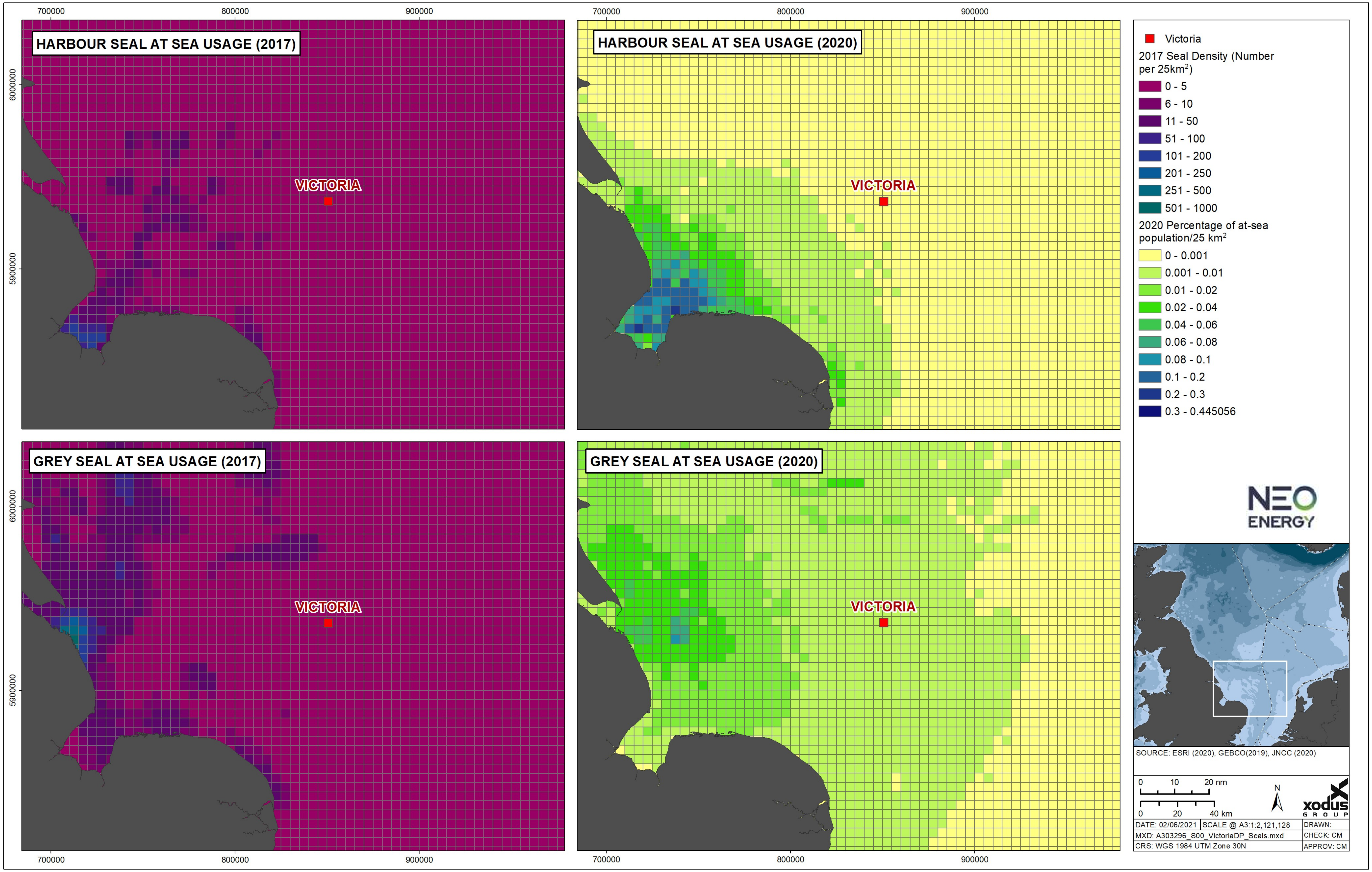

Figure 3-10 - Seal densities in the area of interest

Source: Russel at al. (2018) and Carter *et al.* (2020)

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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 3-6).

Table 3-6 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

The Victoria subsea infrastructure is located within the North Norfolk Sandbanks and Saturn Reef SAC (Figure 3-11) (JNCC, 2017c). The whole site is considered an example of Annex I habitat ‘sandbanks which are slightly covered by sea water all the time’. The sandbank features 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 within the site are areas of Annex I biogenic ‘reef’ habitat formed by the polychaete worm *S. spinulosa* (Table 3-6; Table 3-7). An area of high confidence potential biogenic reef is located approximately 21 km west of Victoria (shown in green in Figure 3-11).

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, approximately 3 km north of Victoria. Given the indication of sand formations in the bathymetry along the pipeline, and the location of Victoria within the North Norfolk Sandbanks and Saturn Reef SAC, this habitat is considered present.

Recent surveys investigating the presence of *S. spinulosa* in Block 49/17 and surrounding areas did not observe evidence of *S. spinulosa* “reef habitat” (ConocoPhillips, 2015). Based on the classification of *S. spinulosa* “reef habitat” (Section 3.2.2) 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 3-7 Protected areas within 40 km of the Victoria decommissioning area

Conservation site	Protected features/ distance from Victoria Field	Conservation Objectives
North Norfolk Sandbanks and Saturn Reef SAC	Designated for: ▪ Annex I habitat '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.	For the features to be in favourable condition thus ensuring site integrity in the long term and contribution to Favourable Conservation Status (FCS) of Annex I Sandbanks which are slightly covered by sea water all of the time and Annex I Reefs. This contribution would be achieved by maintaining or restoring, subject to natural change: • The extent and distribution of the qualifying habitats in the site; • The structure and function of the qualifying habitats in the site; and • The supporting processes on which the qualifying habitats rely.
Southern North Sea SAC	Designated for: ▪ Annex II species harbour porpoise (*Phocena phocena*) Victoria subsea infrastructure located within this SAC.	To ensure that the integrity of the site is maintained and that it makes the best possible contribution to maintaining FCS for Harbour Porpoise in UK waters. In the context of natural change, this will be achieved by ensuring that: • Harbour porpoise is a viable component of the site; • There is no significant disturbance of the species; and • The condition of supporting habitats and processes, and the availability of prey is maintained.

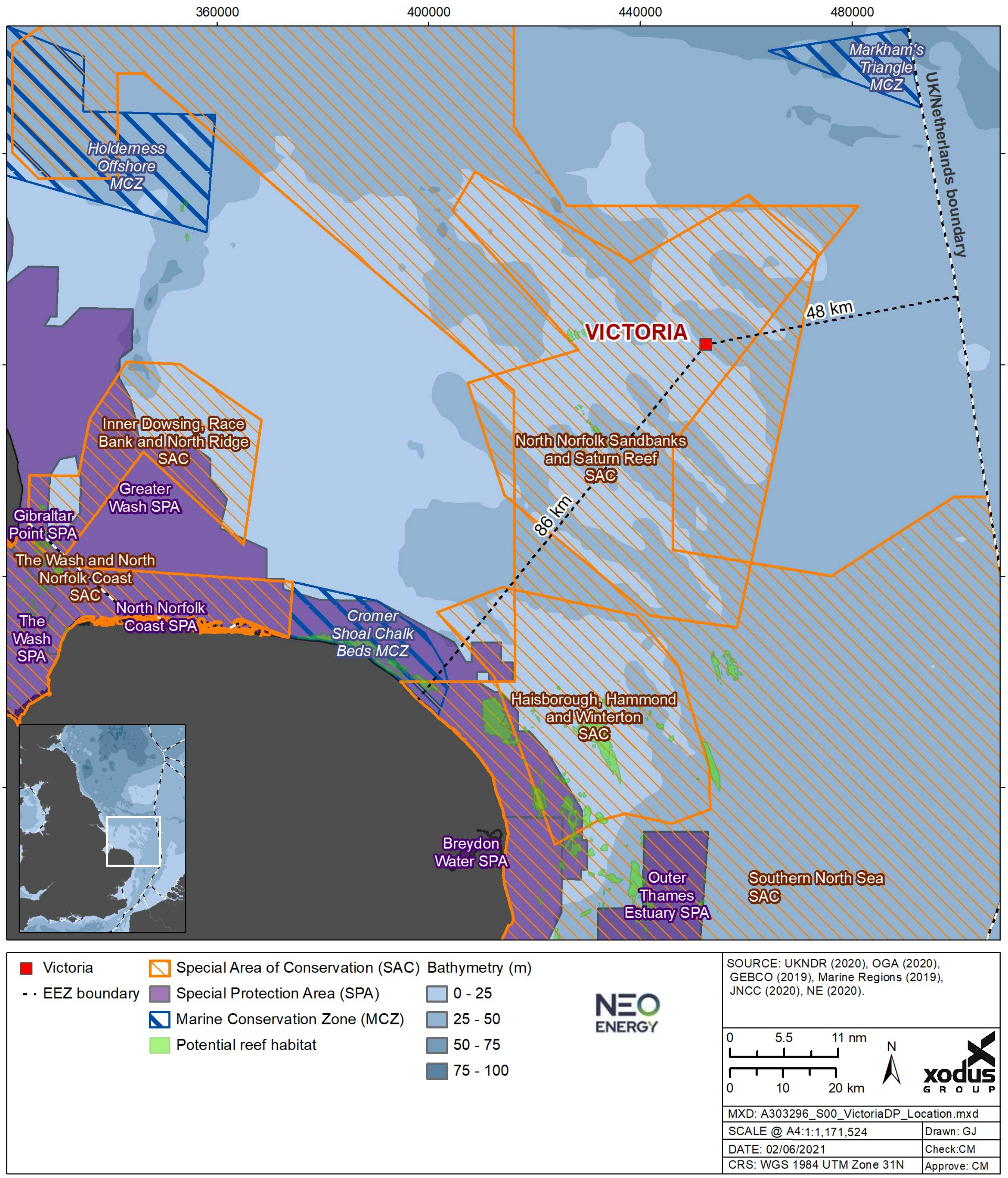

Figure 3-11 - Conservation areas within the vicinity of the Victoria infrastructure

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 3-5; Reid *et al.*, 2003; UKDMAP, 1998). Harbour and grey seal density in Block 49/17 and surrounding blocks is very low (NMPI, 2018; Section 3.2.5)

The Victoria subsea infrastructure is located within the boundary of the Southern North Sea SAC, selected for the protection of harbour porpoise (Figure 3-11; Table 3-5).

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*., 2021) 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*., 2021).

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 SPA (SPA) is located 69 km southwest. The Greater Wash is designated for the protection of over-wintering Red-throated Diver, Common Scoter, Little Gull and breeding Common Tern, Sandwich Tern, Little Tern (Table 3-3; 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 49/17) 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, 2017e).

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 49/17 (Figure 3-11). 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, 2020; Scottish Government, 2020). Statistical data from ICES rectangle 35F2 on the UK fishing effort, provided by the Scottish Government (2020) and live weight of demersal, pelagic and shellfish caught by all UK vessels, provided by the MMO (2020), 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.

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 pipelines, rock-placement or concrete mattresses 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 3-8 summarises the key fishing interests by species type within the vicinity of the proposed decommissioning works.

3.4.1 Fishing Effort

Fishing effort in the vicinity of the Victoria infrastructure was low across all gear types, averaging <500 hours per year between 2013 and 2017. Areas of fishing effort using mobile gear can be found southwest of Victoria while effort with passive gear is west of the area and closer to shore (Figure 3-12; MMO, 2017).

3.4.2 Fishing Quantity and Value

The relative quantity and values of fish landed from ICES rectangle 35F2 has varied through the years. Typically, catch is low across all species types every year, with the exception of 2017. Quantity of catch had historically been predominantly of demersal species until 2019 when shellfish contributed slightly more by weight (Table 3-8). Between 2015 and 2019, the annual total live weight of fish landed from ICES rectangle 35F2 ranged from a maximum of 1,102.88 tonnes in 2017 to a low of 10.13 tonnes in 2018; these catches had a value of £2,169,216 and £20,091 respectively (MMO, 2020) (Table 3-8). Beam trawl was the most utilised gear in ICES rectangle 35F2 (MMO, 2020).

Table 3-8 Annual landings for ICES rectangle 35F2 containing Victoria infrastructure

	Species type	Value (£)	Total value (£)	Quantity (tonnes)	Total quantity (tonnes)
2019	Demersal	24,646	33,762	6.16	12.52
	Pelagic	ND		ND	
	Shellfish	9,117		6.35	
2018	Demersal	15,679	20,091	6.96	10.13
	Pelagic	ND		ND	
	Shellfish	4,412		3.16	
2017	Demersal	1,018,827	2,169,216	668.39	1,102.88
	Pelagic	968		<1	
	Shellfish	1,149,483		413.51	
2016	Demersal	366,215	366,345	84.11	84
	Pelagic	ND		ND	
	Shellfish	130		0.03	
2015	Demersal	283,654	283,800	82.05	82
	Pelagic	ND		ND	
	Shellfish	146		0.05	

Source: MMO (2020)

"ND" refers to no data available

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).

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 3-13).

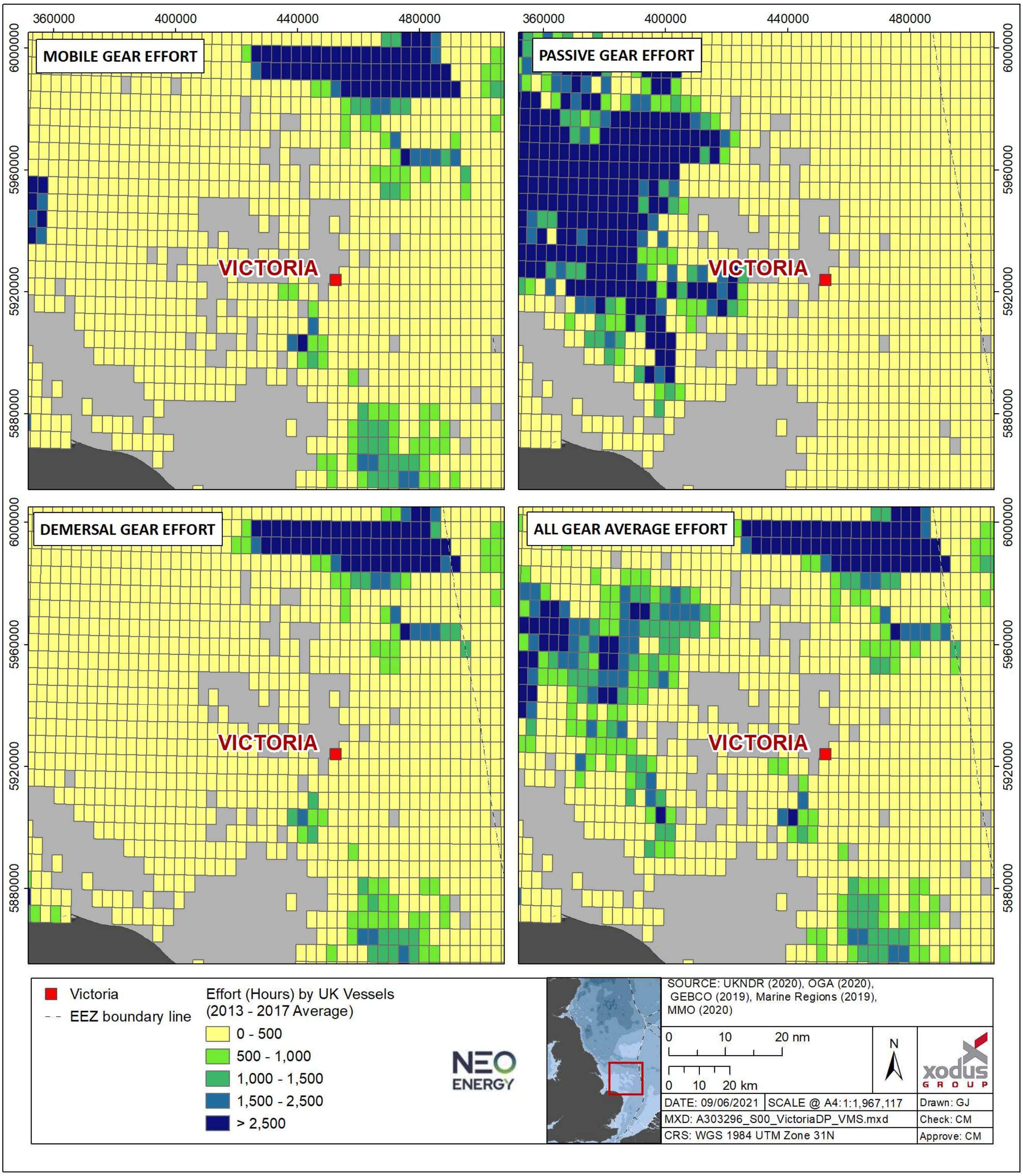

Figure 3-12 Annual average fishing effort (hours) for ICES rectangle 35F2 close to Victoria infrastructure

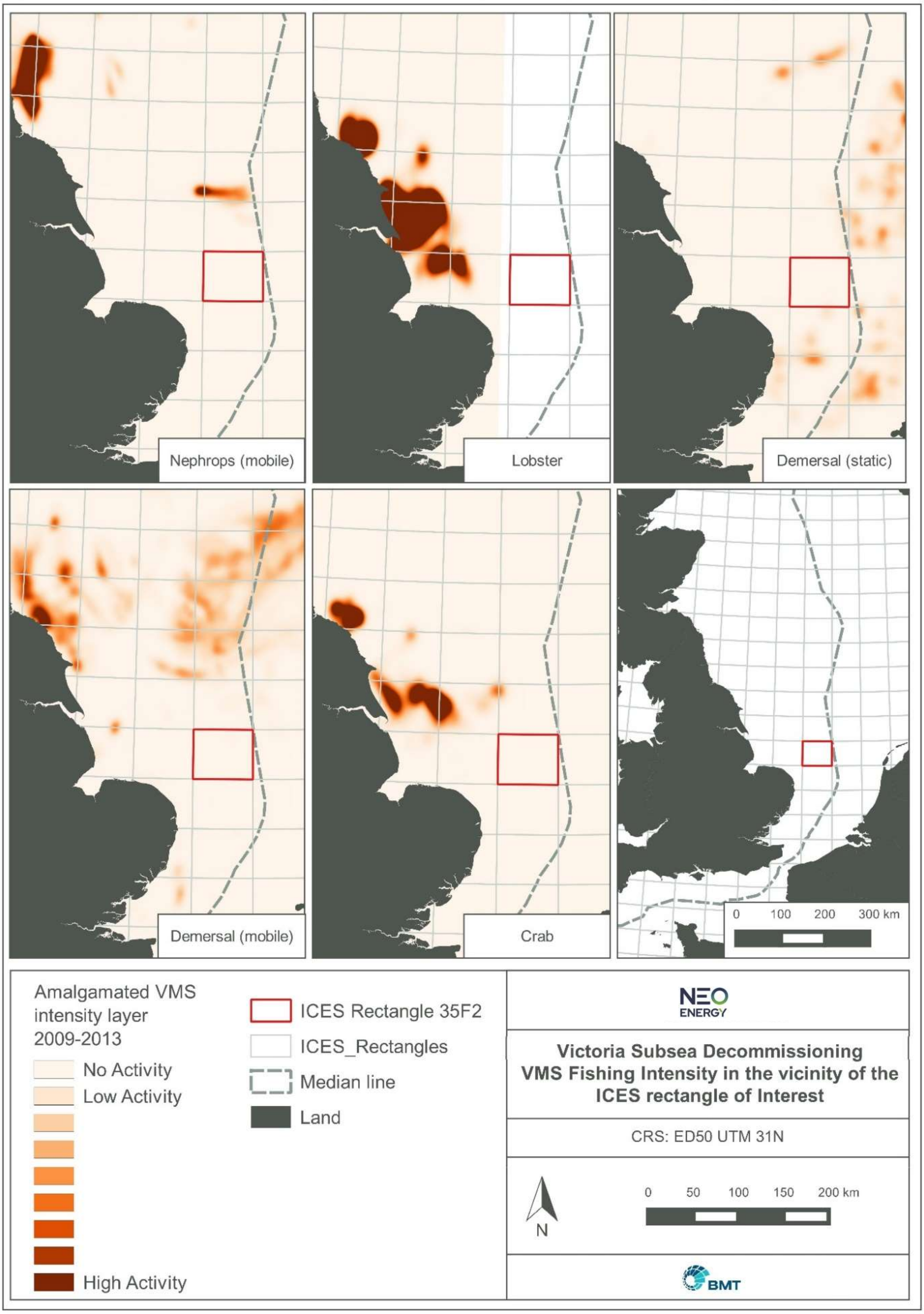

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Figure 3-13 Satellite (VMS) commercial fishing landings figures for 2016.

Source: Kafas *et al*. (2013)

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 3-14) (OGA, 2017). The platforms and other infrastructure located within 15 km from the Victoria subsea infrastructure, are listed in Table 3-9.

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 3-9 Platforms and subsea infrastructures located within 15 km of Victoria subsea infrastructure

Owner	Name	Type	Distance (km)	Direction	Status
Chrysaor Production (U.K.) Limited	Viking B Drilling	Platform	0.13	SE	Platform removed
Chrysaor Production (U.K.) Limited	Viking B Compression	Platform	0.27	NW	Platform removed
Chrysaor Production (U.K.) Limited	Viking B Accommodation	Platform	0.6	NW	Platform removed
Chrysaor Production (U.K.) Limited	Viking Golf	Platform	9.4	W	Platform removed
Chrysaor Production (U.K.) Limited	Viking Delta	Platform	7.87	E	Platform removed
Chrysaor Production (U.K.) Limited	Viking Charlie	Platform	7.48	SE	Platform removed
Chrysaor Production (U.K.) Limited	Viking Hotel	Platform	10.19	N	Platform removed
Chrysaor Production (U.K.) Limited	Viking Lima	Platform	13.49	NW	Platform removed
Alpha Petroleum	Wenlock NUI platform	Platform	14.12	NNW	Operating
Chrysaor Production (U.K.) Limited	Viking Valve Skid	Skid	immediate vicinity (connected to)		

Impacts of Decommissioning Proposals

There_ are also approximately 7 wells and 22 pipelines located within 100m radius of the Victoria subsea infrastructure all of which are out of service and in various stages of decommissioning.

The Victoria pipeline is connected to the Viking BD Skid. The Viking BD Skid is owned by Chrysaor and access to this skid has been granted by Chrysaor to allow the flushing of the Victoria pipeline.

Decommissioning of the Viking BD skid is the responsibility of Chrysaor and not included in the Victoria DP.

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 3-14). 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 3-10; Figure 3-14; Crown Estate, 2017).

3.6.2 Renewables

There are six known areas of windfarm development within 50 km of the Victoria subsea infrastructure (Table 3-10; Figure 3-14; Crown Estate, 2017). Three of these developments are in the pre-planning stages, two sites (Hornsea 1 East and Hornsea 1 West) are currently operational. Hornsea 1 Centre is under construction. Both Hornsea 1 and Hornsea 3 have associated export cables which are 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 & 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 3-9; Figure 3-14).

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 3-14). 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 3-10 - 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 Cable	Hornsea 3 OFTO Export Cable	Consented	49/7, 49/8, 49/12, 49/11, 28/20, 48/19, 48/24, 48/29, 48/28, 48/27, 48/26	17	NW
Windfarm	Hornsea 3	Pre-planning Application	49/2, 49/3, 49/4, 49/7, 49/8, 49/9	40	NW
Windfarm	Hornsea 1 (East)	Operational	49/1, 49/6, 49/7	40	NW
Windfarm	Hornsea 1 (Centre)	Live (under construction)	49/1	45	NW
Windfarm	Hornsea 1 (West)	Operational	48/4	48	NW
Windfarm	Norfolk Boreas	Pre-planning Application	50/21, 49/29, 49/30, 50/26, 53/4, 53/5, 54/1	48	SE
Windfarm	Norfolk Vanguard	Pre-planning Application	48/28, 53/2, 53/3, 53/8	48	S
Windfarm Cable	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)

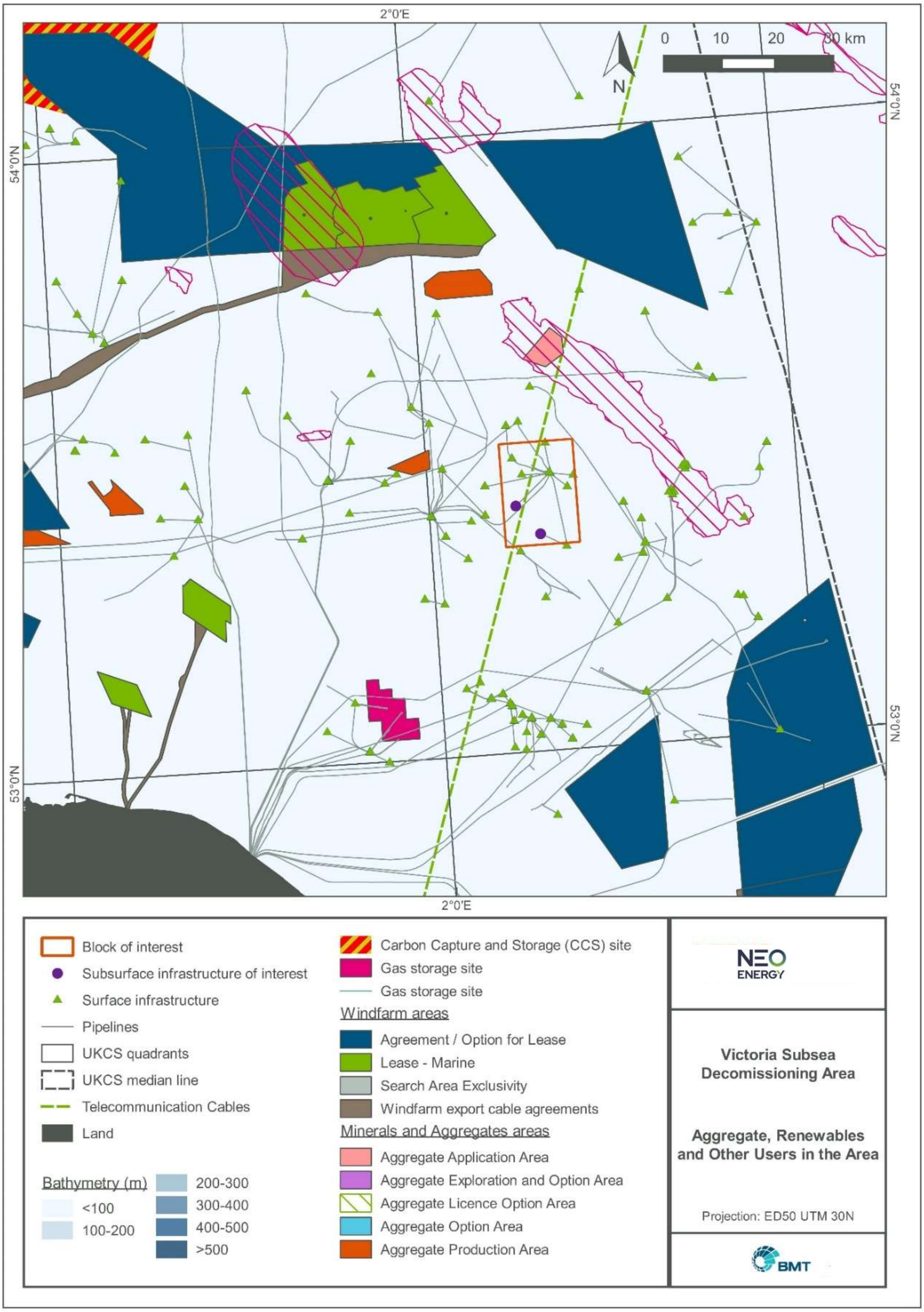

Figure 3-14 Aggregate, renewables and other users of the sea in the vicinity of the Victoria decommissioning area

Source: Crown Estate (2017)

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 3-15. 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 3-11). 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 3-11 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 (probably)	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)

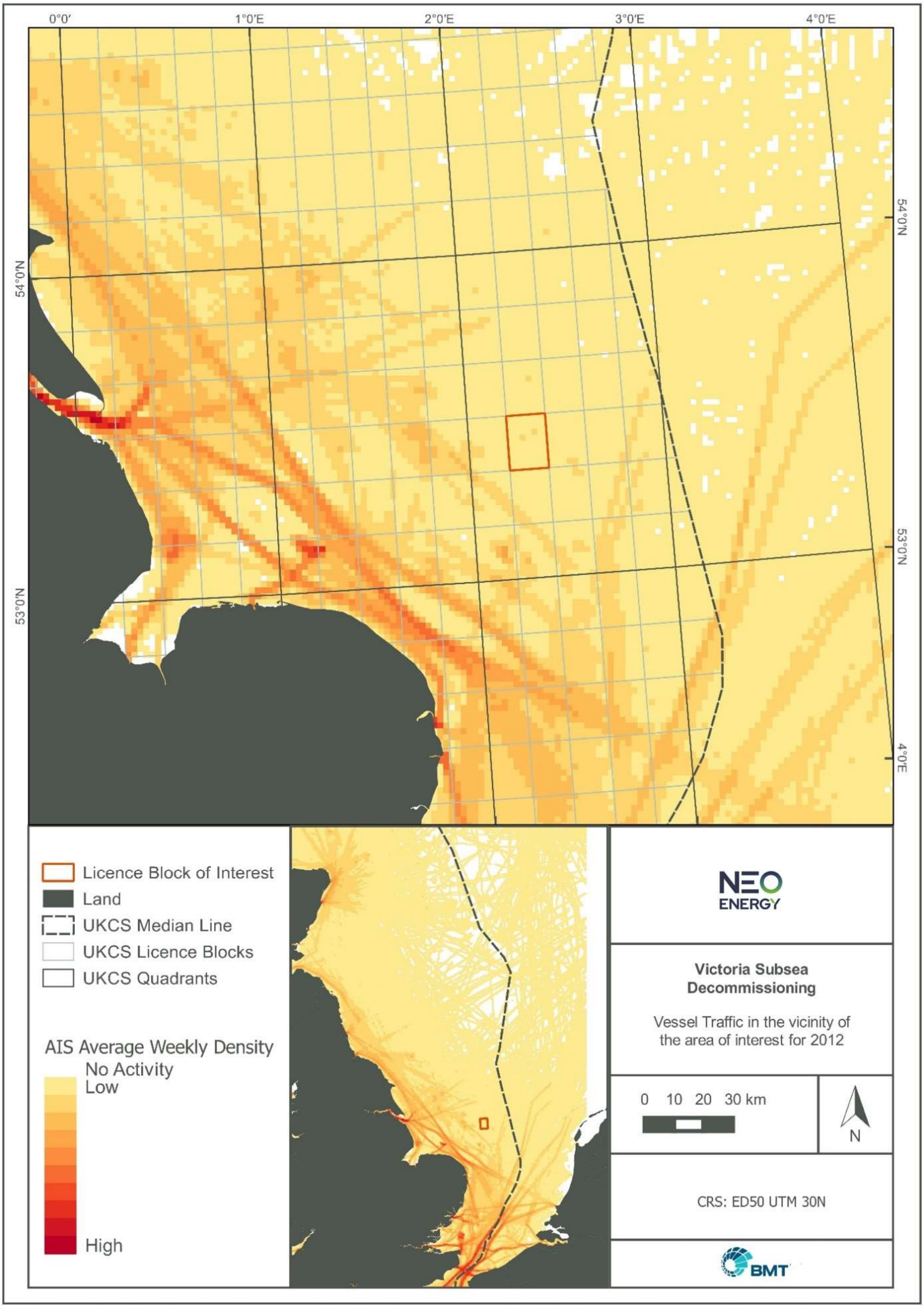

Figure 3-15 Average weekly vessel density near the Victoria decommissioning area in 2012

Sources: OGA (2017), MMO (2014)

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 (in particular and conservation objectives for protected habitats and species);
- 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 in planned and unplanned activity scenarios. 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 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 of impact on environmental and societal receptors				
1	Very unlikely	Planned	Negligible interaction with receptors	<5%
		Unplanned	Never heard of in industry	
2	Unlikely	Planned	Low potential for interaction with receptors	6-20%
		Unplanned	Heard of in industry	
3	Possible	Planned	Moderate potential for interaction with receptors	21-50%
		Unplanned	Has occurred in company	
4	Likely	Planned	High potential for interaction with receptors	51-80%
		Unplanned	Happens several times a year in company	
5	Very likely	Planned	Very high potential for interaction with receptors	81-100%
		Unplanned	Happens several times a year in a location	

Table 4-3 NEO consequence/ severity descriptions

Consequence severity	Seabed	Water	Air	Biodiversity/ Conservation	Societal	Legacy issues
1 (Minor)	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 (Moderate)	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 (Major)	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 (Serious)	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 (Critical)	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 (Minor)	1	2	3	4	5
2 (Moderate)	2	4	6	8	10
3 (Major)	3	6	9	12	15
4 (Serious)	4	8	12	16	20
5 (Critical)	5	10	15	20	25

(green)	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)
(amber)	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
(red)	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 detailed outcome of the risk assessment with the significance assigned to the decommissioning activities is presented in Table 4-5. 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.

Table 4-5: 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		2			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

	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															
															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 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.
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.

	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															
															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 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

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.

For the impacts or risks that were considered to be low, Table 4-5 also provides the justification for excluding these potential impacts and risks from further investigation in the EIA.

5 Seabed Impacts

This section discusses the potential temporary and long-term/ permanent 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 temporary, permanent 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, will determine the impact to species or habitats.

5.3 Source of Potential Impacts

The following activities will potentially impact the seabed at the Victoria field:

- Pipeline decommissioning:

  Dredging/ trenching operations to excavate pipeline at ends (temporary impact).

  Reburial of pipeline ends (and removal of midline section ends) to 0.6 m depth using jetting tools (temporary impact): this method of remediation is the preferred and planned option.

- Full removal of subsea structures:
  - Excavating and cutting operations of the Victoria wellhead and WHPS (temporary impact)
  - Placement of rock material as support/ scour protection for the jack-up rig (long-term impact)
  - Excavating and cutting operations of Victoria skid underwater piles 3 m below seabed (temporary impact).

- Decommissioning of subsea protection materials:

  Recovery of subsea materials, such as mattress, spools, trees, manifolds (temporary impacts).

  Pipeline Residual Contaminant Release:

  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 impact).

It is important to note that rock placement is not a planned activity and is therefore considered a last resort should the effect of scour, if present, become unmanageable to the point that the safety of personnel or the integrity of the rig and well systems are compromised. In the context of stabilisation with the intention to prevent scour, the rock mentioned here is more likely to be gravel.

Structures and materials to be removed as part of Victoria decommissioning activities and the approximate seabed area of disturbance of the are presented in Table 5-2. The table presents the estimates associated with the worst-case activities listed above. Victoria is located within the North Norfolk Sandbanks and Saturn Reef and Southern North Sea SACs, therefore the areas of seabed impact are entirely within these sites.

Table 5-1 Structures and decommissioning activities with the potential to impact on the seabed

Item placed/ removed from the seabed	Dimensions	Temporary seabed impact (km^2)	Long-term seabed impact (km^2)
Victoria wellhead and WHPS	5.8 m long x 5.8 m wide	0.00003	-
Placement of the drill rig	Maximum of 3 spudcans of 22 m^2	0.00007	-
Stabilisation of the drill rig	Maximum of 3 spudcans requiring a maximum of 200m^2 /1000Te of rock per leg	-	0.0006
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)	0.0013	-
Umbilical spools and ends	270 m (total length of umbilical spools and ends for removal) x 5 m (width of affected corridor)	0.0014	-
Exposed midline sections on pipeline	240 m (total length of exposures for removal) x 5 m (width of affected corridor)	0.0012	-
Exposed midline sections on umbilical	240 m (total length of exposures for removal) x 5 m (width of affected corridor)	0.0012	-
Concrete mattresses for removal	90 mattresses x 6 m long x 2.4 m wide	0.0013	-
Frond mattresses	13 mattresses x 6 m long x 2.4 m wide	0.00019	-
Grout bags	Maximum of 242 grout bags (estimated to be a standard 0.6 m long x 0.3 m wide)	0.00004	-
Palette and speed loader (which will be used to remove the mattresses and grout bags)	Palette: 32 m^2 (x 4 uses) Speed loader: 18 m^2 (x 21 uses)	0.00051	-
TOTAL		**0.007**	**0.0006**

5.3.1 Pipeline decommissioning

Since the pipeline and umbilical ends are already buried or partly buried, localised excavation will be required to allow cutting and removal of the trench transition sections. Such excavation shall be performed by diver and/or a work class ROV, with the excavated sediment being deposited down-current where it will undergo natural dispersal. The dredging and trenching operations at this scale would be expected to physically disturb the seabed sediments and benthos local to the pipeline ends. However, the remaining and open trench transition profiles shall thereafter rely on natural backfill to provide infill. Given the dynamic nature of the surface sediment in this area of the SNS, NEO deem re-burial to be the most suitable remediation option.

The recent April 2021 burial status survey also confirmed that six distinct sand waves are present along the pipeline route that are seen to have migrated westwards, with greater movement being noted for the two most easterly wave profiles (Figure 5-1). The results of the 2021 survey also show that significant loss of cover has only occurred in relation to sand waves 5 & 6 and that the pipeline continues to remain buried with reasonable soil cover at the remaining four sand wave locations (Figure 5-2). Any future exposure at these four locations will be identified during planned inspection activities and remediation will be removal or reburial to > 0.6 m depth. It is noted that migration of sand waves 5 & 6 has already resulted in some minor “crown of pipe” exposure with further uncovering predicted to occur over time (Figure 5-3). To mitigate against the above risk of further exposure it is therefore the intent that approximately 240 m of pipeline and umbilical be cut and removed from within sand waves 5 and 6 as part of the 2022 decommissioning campaign.

NEO will not be using rock cover as remediation for existing or future pipeline and umbilical exposures and are aware that this would be an additional and permanent change in substrate type within the North Norfolk Sandbanks and Saturn Reef SAC and Southern North Sea SAC. The temporary seabed disturbance associated with the excavation of the pipeline and umbilical ends and removal of the exposed sections is estimated to be 0.005 km^2. This represents 0.00014% of the total area of the North Norfolk Sandbanks and

Saturn Reef SAC (3,603 km²; JNCC, 2017c) and 0.000013% of the total area of the Southern North Sea SAC (36,951 km²; JNCC, 2017d).

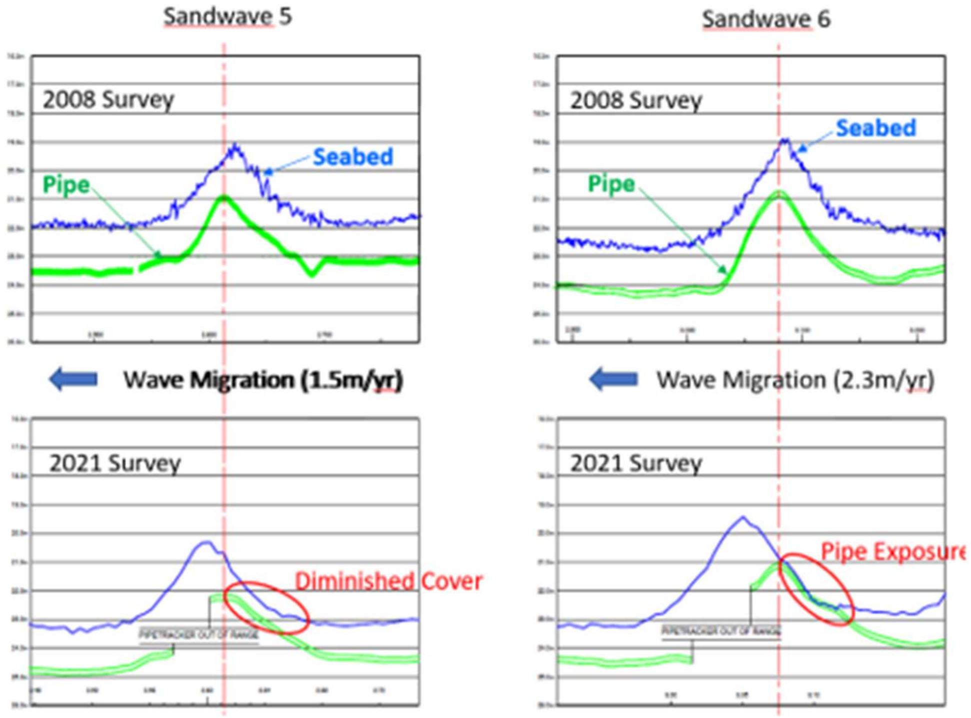

Figure 5-1 2008/2021 survey results for sandwaves 5 and 6

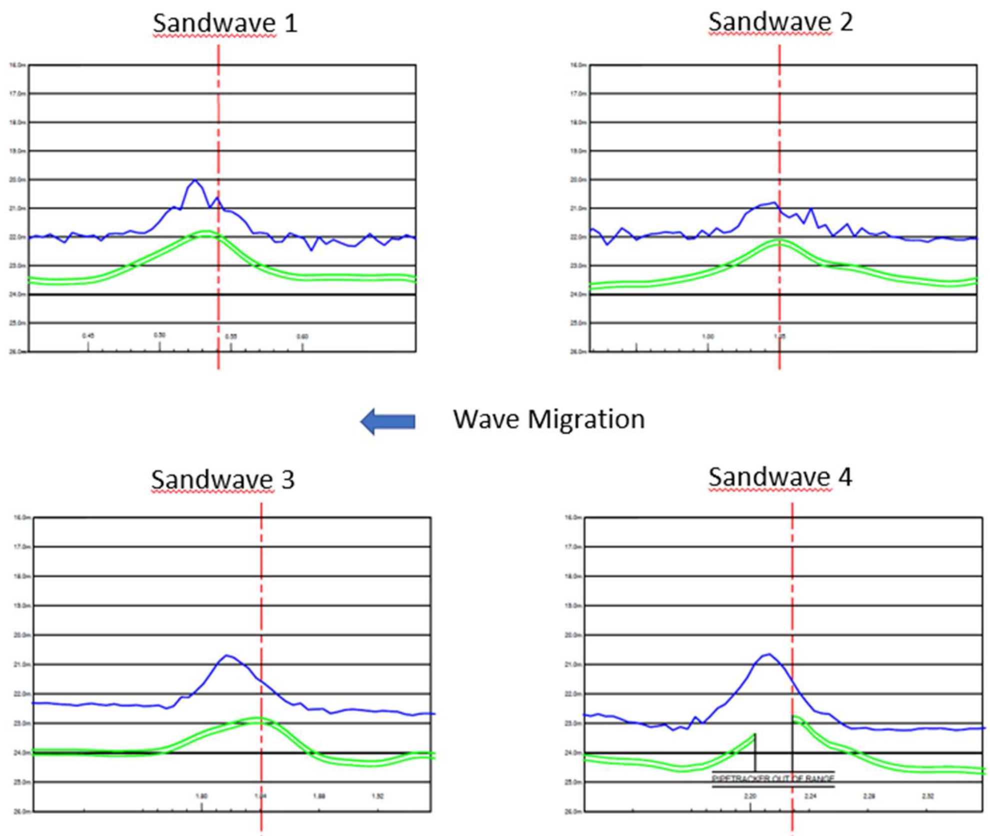

Figure 5-2: 2021 survey results for sandwaves 1,2,3 and 4

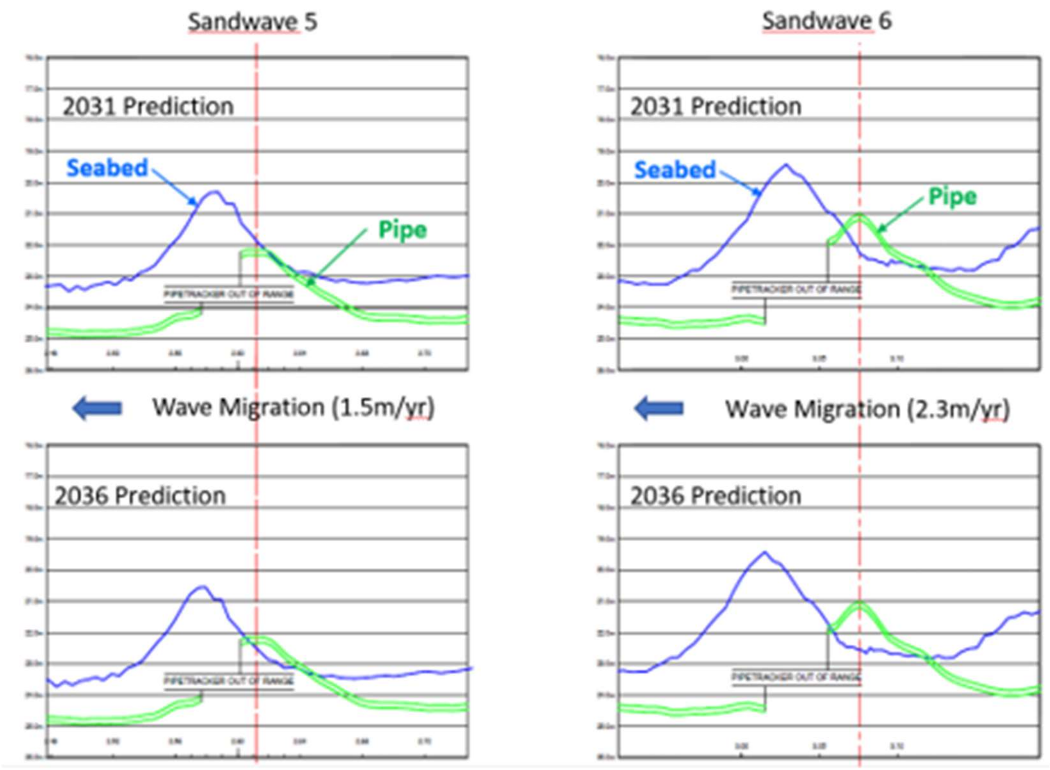

Figure 5-3: Exposure predictions for sandwaves 5 and 6

5.3.2 Full Removal of Subsea Structures

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 cut internally using high pressure water abrasive and removed to approximately 3 m below the seabed. Due to the highly mobile nature of sediments in the SNS, it is expected that any voids remaining in the seabed due to the removal of the piles will infill naturally. The direct impact associated with cutting and removal of the underwater piles in the Victoria valve skid will create a temporary disturbance of the seabed sediments and benthos, over an estimated area of 0.3 m^2 (Table 5-1).

The Victoria wellhead and integrated WHPS is only secured to the seabed by the wellhead itself, and the WHPS is sitting on the seabed. The wellhead will be cut using internal rotary methods at approximately 3 m below the seabed and the WHPS legs will be retracted prior to lift. The direct (temporary) impact on the seabed of the removal of the wellhead and WHPS is expected to fall within the footprint of the WHPS and is estimated to be a maximum of 0.00003 km^2 (Table 5-1).
The removal of the WHPS will be undertaken from a three-legged jack-up rig as part of well P&A operations, however, as the placement and stabilisation of the rig is integral to the removal of this structure, the activities associated with this have also been assessed as part of the subsea structure decommissioning operations.

The rig will be located to its working position adjacent to the Victoria well and will only be required at a single location. There will be a seabed impact from the jack-up spudcans. The need for anchoring is not anticipated for the Victoria decommissioning project. The worst-case temporary seabed disturbance associated with the spudcan positioning is 0.00007 km^2 (three spudcans each of an area of 22 m^2).

In addition to this temporary impact, gravel placement may be required for stabilisation of the jack-up. This is to mitigate against the potential formation of scour due to the placement of the jack-up rig. A three-legged jack-up may require an estimated 200 m^2 of rock per leg. This equates to 0.0006 km^2 of permanent impact, within which the spudcans would sit (Table 5-1).

5.3.3 Decommissioning of Subsea Protection 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.

Mattresses and grout bags are used to provide support and stability to infrastructure in-field. It is therefore likely that some will be stacked on top of one another and overlapping. There are 150 concrete mattresses in the Victoria Field: 60 at the Victoria valve skid; 45 associated with the AR pipeline crossing; and 45 at the Viking end of the PL2526 / PLU2527. Of these mattresses, 60 are being decommissioned *in situ*; those which are associated with the crossing and the trenched section of the umbilical. An additional 13 frond mattresses are also located around the Victoria xmas tree (Appendix B). Overall, 90 concrete mattresses and 13 frond mattresses are to be fully removed during decommissioning.

There are an estimated 242 grout bags in the field. In the interest of presenting a worst-case scenario with regards to seabed impacts, it has been assumed that the mattresses / grout bags are individually laid out in a single layer on the seabed.

In addition to the footprint of impact associated with the mattresses and grout bags themselves, there will be an additional area of impact attributed to the palette and speed loaders which will be used in the removal process. The palette and speed loader have dimensions of 8 m long x 4 m wide and 6 m long x 3 m wide respectively. Four uses of the palette are anticipated to be required and an estimated 21 uses are expected to be required of the speed loader to remove all the mattresses and grout bags.

The seabed disturbance associated with the removal of the subsea materials is anticipated to be temporary and affect a combined area of up to 0.006 km^2 (Table 5-1).

5.3.4 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.

5.3.5 Clear Seabed Surveys

Due to sensitive environmental setting in the Victoria area, the appropriate post decommissioning survey methods will be remote and non-intrusive and will be discussed and agreed with OPRED in due course.

5.4 Temporary Impacts

The seabed impacts resulting from the decommissioning activities associated with the Victoria decommissioning can be classified as temporary or permanent. Temporary impacts are defined here as those which have transient impacts lasting a few days to a few years. Permanent impacts are those which will continue to have an impact for decades to centuries following decommissioning.

5.4.1 Temporary Impacts

Seabed impacts may occur due to excavation, jetting and cutting activities. Recovery of subsea materials 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 Permanent and Long-Term Impacts

Permanent and long-term impacts associated with the Victoria decommissioning relate to the physical/ chemical breakdown and the physical presence of the pipeline and umbilical decommissioned *in situ*. The likely long-term impacts arising from these impacts can be summarised as:

- Sediment morphological change (specifically around the presence of the North Norfolk Sandbanks and Saturn Reef SAC); and
- Benthic fauna disturbance.

5.5 Temporary 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 Sediment Disturbance

The dynamic seabed environment in this area of the SNS 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.

Any disturbance will be relatively localised and occur due to the seabed excavation (where required), diver and ROV manoeuvring, and the use of pipe and umbilical 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 seabed excavation activity and to ensure the accurate placement of jetting, cutting and lifting equipment.

The scale of the disturbance is small when compared to other forms of disturbance that occur in the area, such as commercial trawling. A commercial trawler with a 12 m wide beam trawl trawling at its slowest rate of approximately 4.7 km/h would cover an area of roughly 0.006 km^2 per hour (FAO, 2019) so would therefore take less than an hour to cover the anticipated direct disturbance area. Despite fishing activity being low (Section 3.4), in this context, the limited scale of the disturbance associated with the decommissioning activities is clear.

Any disturbance to the benthic fauna will be short-term and confined to the survey area. 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.

Furthermore, 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, and item removal activities will physically disturb the sediment in the local area. The seabed sediment disturbance will be temporary, localised and confined to an estimated area of, approximately, 0.007 km^2. This represents 0.00019% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC (3,603 km^2; JNCC, 2017c) and 0.000019% of the total area of the Southern North Sea SAC (36,951 km^2; JNCC, 2017d). Temporary seabed impacts are expected to be short-term and not significantly impact the conservation features of either SAC. Given the dynamic seabed conditions, re-burial and recovery of the surface seabed and associated fauna is expected to take up to one year.

The direction of sandwave travel is mostly in line with the east-west routing of the buried pipeline and it is considered there will be little or no impact on movement of the sand. A comparison between the 2008 and 2021 surveys (Appendix B) shows that, with the exception of the two most easterly sandwaves regions (designated sand waves 5 and 6), both the pipeline and umbilical have continued to remain buried over this 13-year time interval with little or no loss of sediment cover. For the two anomalies mentioned, the easterly migration of the sandwaves has resulted in either a significant reduction of cover (sandwave 5) or actual pipe exposure (sandwave 6). Further migration of these two said waves will exacerbate such concerns, hence, the proposal to cut and remove the at-risk sections. Decommissioning the pipeline and umbilical infrastructure in situ will minimise the disturbance to the environment and hence should have little or no impact on sandwave morphology.

Based on past survey results together with predictions of sandwave movement, only pipe and umbilical sections within sandwaves 5 and 6 are considered to be at risk of future exposure. Therefore, with the proposal being to remove such at risk sections there will be no pipe free spanning and hence no reason to instigate any remediation measures.

5.5.2 Benthic Fauna Disturbance

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. Another factor in recovery rate is the hydrodynamic regime of the local area. The Indefatigables within the North Norfolk Sandbank system, and just east of Victoria, are considered examples of tidal sandbanks in moderate current strength waters (JNCC, 2010).

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) in shallower areas of the UKCS (DECC, 2011), as at Victoria. 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, sprat and whiting (Section 3.2.3) (Coull *et al*., 1998; Ellis *et al*., 2012). However, the area is unlikely to be used by benthic spawners during the proposed operational period; species like sandeel (which are the main prey for harbour porpoise) spawn in the winter months and therefore spawning is unlikely to coincide with project activities (Section 3.2.3).

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 0.007 km^2, equivalent to 00019% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC (3,603 km^2; JNCC, 2017c) and 0.000019% of the total area of the Southern North Sea SAC (36,951 km^2; JNCC, 2017d) as stated previously. Overall, no significant impacts are expected on the benthic fauna and associated habitats underpinning the conservation objectives (Table 3-7) of either SAC. Given the limited scale and temporary nature of the decommissioning operations, it is not expected that the structure of the sandbanks or sandeel habitat will be compromised.

5.6 Permanent and Long-Term Impacts on Sensitive Receptors

The following sections describe the impact associated with decommissioning the existing pipeline *in situ*, the potential for the placement of stabilisation material (gravel) for the jack up rig legs and the long-term impact from release of the contaminants as pipeline material degrades over time.

5.6.1 In Situ Pipeline Decommissioning

The rate at which sandbanks (such as those within the North Norfolk Sandbanks and Saturn Reef SAC) are reported to move varies depending on their location. It is difficult to determine the exact rate of movement of sandbanks within the SAC, however observations of water movement, sand wave asymmetry and sand tracers support an offshore sand transport component within the site. It is thought that they are elongating very slowly (JNCC, 2010). Within the North Norfolk Sandbanks and Saturn Reef SAC, the Indefatigable Bank was regarded as having remained more or less stable between 2013 and 2016, whereas the Leman Bank (also within SAC but further southwest and closer to shore) was estimated to have migrated 30 m north west in the same timeframe (Eggleton *et al*., 2020). As Victoria is located closer to the Indefatigable Banks, it is likely that the rate of sandbank movement in the region of the decommissioning activities is relatively slow.

Bathymetry data collected within the Victoria field, show evidence of sandwaves along the pipeline route (see Figure 3-2). The presence and continuation of these features in areas containing subsea installations suggests that small scale installations do not present barriers to sandbank maintenance or formation. DoB data along the Victoria pipeline indicates that it has mostly remained stably buried over time; one particular pipeline exposure has arisen as a result of sand wave migration, which further suggests that the sand formations in the area are not impeded by the presence of the pipeline (Appendix B). As such, it is not expected that the elongation and subsequent alteration in structure of the sandbanks will be compromised by the decommissioning of the pipeline and umbilical *in situ*. As described above, the predicted recovery of a dynamic area from disturbance is likely to be relatively rapid. Overall, in considering the Conservation Objectives of the North Norfolk Sandbanks and Saturn Reef SAC, the presence of the pipeline and umbilical is unlikely to affect the extent and distribution of the sandbank habitat, nor its natural functionality.

5.6.2 Stabilisation of Rig During Well Decommissioning

Given the environmentally sensitive location of the WHPS within both the North Norfolk Sandbanks and Saturn Reef and Southern North Sea SACs, NEO are fully aware that the addition of a non-native seabed material within this area could be detrimental. NEO have therefore considered all alternatives to jack-up use (Section 5.6.2.1), investigated the likelihood that scour will occur and that stabilisation material would be required by considering historical precedence (Section 5.6.2.2), have carefully considered the operations approach (Section 5.6.2.3) and in the unlikely scenario that stabilisation is required, have considered a worst-case scenario of seabed impact and the potential for recovery (Section 5.6.2.4).

5.6.2.1 Consideration of alternatives

Multiple rig types have been considered for this well abandonment however the shallow water depth at the Victoria location rules out the use of other rig types such as semi-submersibles (DECC, 2015) and drill ships. A light well intervention vessel was also considered during the early stages of planning but does not have the capabilities for full reservoir abandonment or the lift capacities required to complete the work programme. Therefore, a jack-up rig is the only feasible option for the Victoria decommissioning work scope.

Proactive alternatives to gravel placement such as pre-locating gravel bags, frond mattresses or netting have been considered but the level of risk of seabed instability does not justify their use which would also have an environmental impact.

5.6.2.2 Precedence for the requirement of seabed stabilisation

- The Ensco 80 and the Ensco 100 jack-up rigs have been located at the Victoria location.
- The Ensco 80 was on location for 63 days during the winter months in 2006/07 with no recorded incidents of scour.
- The Ensco 100 was on location in 2008 for a total of 45 days during the summer months. The first instance of scour was noted 17 days after commencement of operation. Over the following 7 days attempts were made to counter-act scour by jacking up the rig
- It was observed that seabed scouring was continuing to cause significant rig settlement outwith acceptable limits to continue with well operations. The decision was therefore made in consultation with the drilling contractor to introduce gravel stabilisation over the spud cans prior to proceeding with well operations and to prevent further rig settlement.
- 24 days after commencement of operations the rock placing vessel was on location and a seabed sonar survey was performed.
- Rock dumping was able to successfully mitigate the scour issues, an as laid sonar survey was then performed.

As the planned duration of the Victoria well decommissioning scope is 20 days (plus 5 days for waiting on weather which is less likely to be required during the summer months), it is less likely that scour mitigation will be required during this short work scope.

5.6.2.3 Approach

During well decommissioning operations, the following steps will be undertaken to minimise the likelihood of the requirement for gravel placement:

- Pre-loading of rig to simulate maximum anticipated loads
- Rig-based ROV inspection following pre-load, evaluate inspection and re-locate spud cans if necessary
- Perform ROV inspections of spud cans at frequent intervals and following adverse weather, as instructed by the rig Offshore Installation Manager (OIM)
- In the event of seabed instability, the primary action taken will be to re-level the rig by jacking
- If step previous step is unsuccessful jack down and reposition spud cans, repeat pre-load operation
- ROV survey results to assist with targeted rock dump program to minimise material required
- Vessel based ROV to be utilised to target rock dump areas of concern

5.6.2.4 Potential seabed impact

The placement of a maximum of 3,000 Te of gravel (1,000 Te per leg) would create some long-term, yet recoverable, disturbance of seabed sediments, over an estimated area of 0.0006 km^2, representing

0.000016% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC and 0.0000016% of the Southern North Sea SAC.

An ROV general visual Inspection of the Victoria WHPS location was performed in April 2021 (ODE Asset Management, 2021). Figure 5-4 shows the previous rig locations in context with the local bathymetry and shows no evidence of the gravel stabilisation or spud can indentations from the operations in 2006 -2008, indicating that sediment reburial has occurred since.

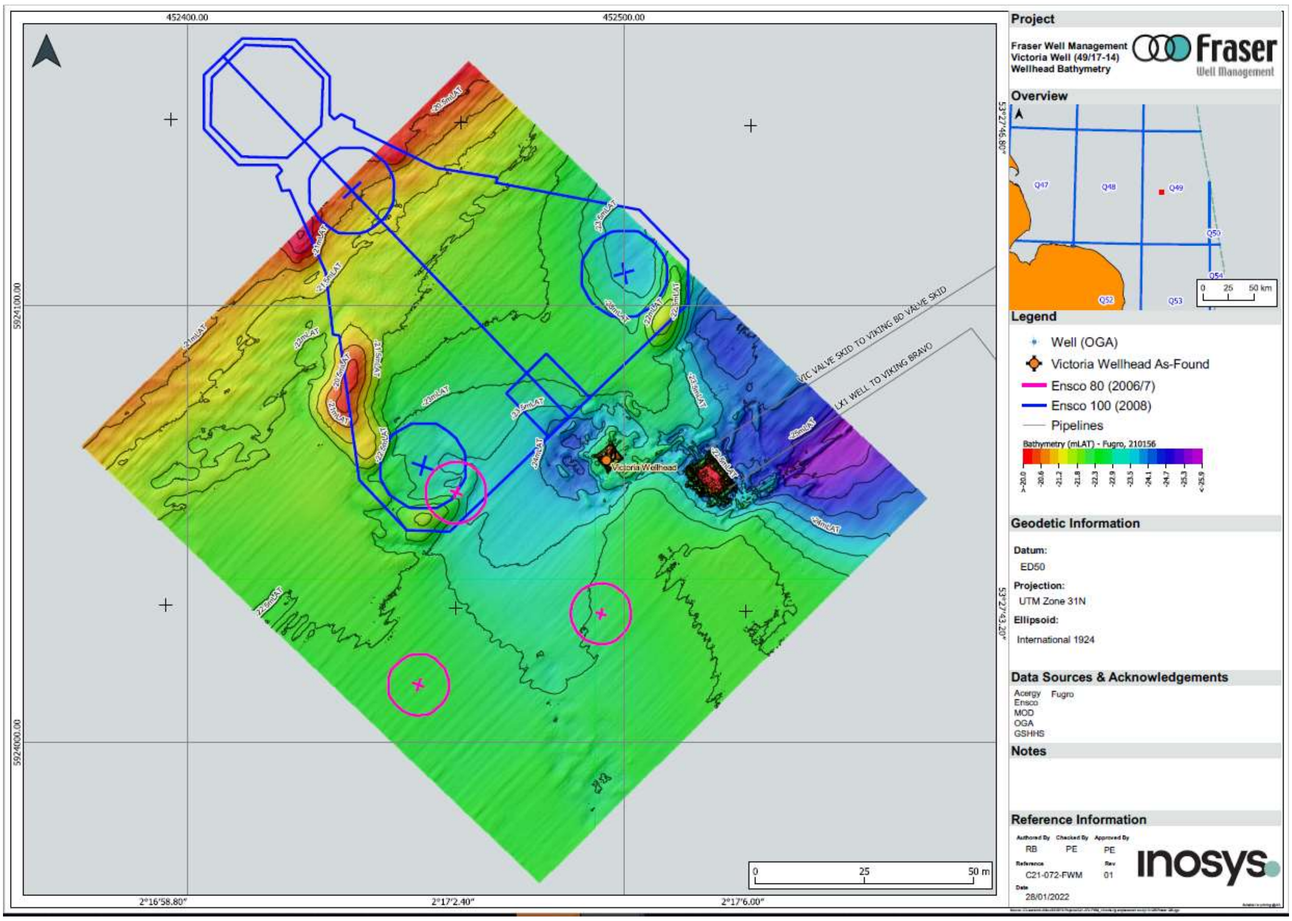

Figure 5-4 Previous locations of jack up rigs (2006 – 2008) in context with 2021 bathymetry data

Further evidence to support this reburial is demonstrated by the of mattresses shown between 2010 and 2012 video surveys in the vicinity of the WHPS. As such, the reburial and recovery the seabed is expected to take a maximum of two years. Given the minimal scale of the footprint and the expected recovery time, it is not expected that the structure of the sandbanks or the habitat of harbour porpoise prey will be affected by the proposed decommissioning activities, or that the conservation objectives of either site will be compromised.

5.6.3 Pipeline Degradation

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 and the water column. No rock placement is planned during pipeline or umbilical decommissioning operations. 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.

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.

5.6.3.1 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 Table 5-2 and Table 5-3, respectively. The bulk constituent of the steel is iron (98.1899 – 99.9999%).

Table 5-2 Pipeline steel (API 5L-X65) chemical components

Element	Composition (maximum %)
Iron (Fe)	Bulk
Manganese (Mn)	1.40
Carbon (C)	0.24
Phosphorus (P)	0.025
Sulphur (S)	0.015
Titanium (Ti), Niobium (Nb), Vanadium (V)	Combined (<0.01)

Table 5-3 Umbilical chemical components

Material	Approximate Composition (maximum %)
Plastics	80
Metal	16
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 5-4.

Table 5-4 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 5-4 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 behaviour, 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.

5.6.3.2 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

The seabed sediment disturbance will be temporary, localised and confined to an estimated area of, approximately, 0.007 km^2. This represents 0.00019% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC (3,603 km^2; JNCC, 2017c) and 0.000019% of the total area of the Southern North Sea SAC (36,951 km^2; JNCC, 2017d). Long-term impacts associated with the stabilisation of the drill rig (if required) are expected to create a maximum permanent seabed impact of 0.0008 km^2, representing 0.00002% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC and 0.000002% of the Southern North Sea SAC.

The following sections quantify the area of impact which will act cumulatively with the proposed Victoria decommissioning 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.

5.7.1 Other Activities within the North Norfolk Sandbanks and Saturn Reef SAC

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

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

Table 5-5 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)*	Area within NNSSR SAC (%)	Area within SNS SAC (%)
A-Fields well abandonment	Centrica	Decommissioning Programme	0.0029	0.0	0.00008	0.0000078
Ann and Alison	Centrica	Decommissioning Programme	15.3924	0.0252	0.4279	0.0417244
Annabel and Audrey	Centrica	Decommissioning Programme	11.6753	0.0810	0.3263	0.0318159
Viking and LOGGS	Harbour Energy	Decommissioning Programme	0.0144	0.6208	0.0176	0.0017190
Leman BH	Shell	Decommissioning Programme	0.4058	0.0	0.0113	0.0010982
Hornsea Project Three	Dong Energy	Windfarm development	10.38	-	0.2881	0.0280913
TOTAL			**37.88**	**0.73**	**1.07**	**0.1**

* Note that the areas of permanent impact shown in Table 5-6, associated mostly with rock placement, reflect the quantities of rock which have been accounted for through permits – this is not necessarily representative of the actual quantities of rock placed on the seabed and thus is likely to be an overestimate.

The North Norfolk Sandbanks and Saturn Reef SAC is designated for the presence of Annex I habitats 'sandbanks, which are slightly covered by seawater all the time' and biogenic 'reefs'. The whole site is considered to be Annex I sandbank habitat with conservation objectives aiming to ensure long term integrity of the site. The additional third-party activities listed in Table 5-5, will affect up to 1.07% of the SAC and of the sandbank habitat (3,603 km^2). The Southern North Sea SAC is designated for the protection of the Harbour porpoise population. The cumulative activities outlined here will affect up to 0.1% of the habitat which supports sandeel, which are the main prey of harbour porpoise.

The decommissioning activities causing an impact to the seabed at Victoria, as shown in Table 5-1 (when added to the totals presented in Table 5-5) represent 0.019% of the total cumulative temporary impact 0.1% of the total cumulative permanent impact, reflecting the small scale of the project.
The Victoria field activities are located approximately 21 km from any area of high confidence *S. spinulosa* biogenic reef, therefore the proposed decommissioning activities will not act cumulatively with others to disturb the biogenic reef habitat, as the activities are not likely to affect this habitat alone.

5.8 Proposed Mitigation Measures

Mitigation measures to minimise seabed impacts within the Victoria decommissioning area are detailed in Table 5-6.

Table 5-6 Proposed mitigation measures for seabed impacts

Potential source of impact	Proposed mitigation measures
Impact on the seabed area due to cutting and lifting procedure	Cutting and lifting operations will be controlled by diver and/or ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment.
Impact on the seabed associated with excavation activities	The requirements for further excavation will be assessed on a case-by-case basis and will be minimised to provide access only where necessary. Internal cutting will be used preferentially where access is available.
Interaction between vessel anchors and seabed	Vessels will be equipped with dynamic positioning (DP) rather than relying on anchors to remain in position. The jack-up rig will not be using anchors for positioning.
Impact on the seabed associated with the introduction of hard substrate through rock placement	If required for spudcan support, gravel remediation will be carefully placed over the designated areas of the seabed by the use of a fall pipe system. This will control the profile of the gravel covering and accurate placement of rock on the seabed to ensure gravel is only placed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance. During decommissioning planning a study will be conducted to determine if the effects of scour can be mitigated through the rig selection process by considering the size, profile, design of spud cans and jack-up leg configurations. Thus, rock placement is not a planned activity and is considered a last resort should the effect of scour, if present, becomes unmanageable to the point that the safety of personnel or the integrity of the rig and well systems are compromised.
Potential snagging risk arising from rock placement	Once the drill rig has departed the field, the profile of the gravel adjacent to the spudcan locations (if required) will allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging fishing gear.
Potential impact on sensitive species and habitats	A review of survey data collected in the area will be reviewed for potential sensitive habitats of seabed and mitigated against as appropriate.
Long-term impacts on seabed habitat associated with the decommissioning activities	Post decommissioning debris clearance, surveys and monitoring shall be carried out using non-intrusive methodologies such as ROV inspections.

5.9 Conclusions

The proposed excavation, cutting, and item removal activities will physically disturb the sediment in the local area. The seabed sediment disturbance will be temporary, localised and confined to an estimated area of, approximately, 0.007 km^2. This represents 0.00019% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC (3,603 km^2; JNCC, 2017c) and 0.000019% of the total area of the Southern North Sea SAC (36,951 km^2; JNCC, 2017d). Removal of exposed (and potential future exposures) pipeline and umbilical sections, and the decommissioning of the remaining pipeline and umbilical infrastructure in situ will minimise the disturbance to the environment and hence should have little or no impact on sandwave morphology.

Temporary seabed impacts are expected to be short-term and not significantly impact the conservation features of either SAC. Given the dynamic seabed conditions, re-burial and recovery of the surface seabed and associated fauna is expected to take approximately one year. Overall, no significant impacts are expected on the benthic fauna and associated habitats underpinning the conservation objectives (Table 3-7) of either SAC. Given the limited scale and temporary nature of the decommissioning operations, it is not expected that the structure of the sandbanks or sandeel habitat will be compromised.

A jack-up rig will be utilised for the removal of the Victoria integrated WHPS and will be placed adjacent to the Victoria wellhead during decommissioning operations. Following the placement of the spudcans on the seabed, gravel stabilisation material may be required to prevent scour and help stabilise the rig. Every endeavour will be made to avoid this requirement, including site surveys, identification of further mitigation including pre-loading of the rig to simulate maximum loads, frequent ROV inspections, re-levelling of the rig and re-positioning of the spudcans. In addition, the duration of the activities (20 days plus 5 days wating on weather) is shorter than a previous campaign where stabilisation was required and it is unlikely that scour will have time to develop during this time period.

Long-term impacts associated with the stabilisation of the drill rig (if required) are expected to create a maximum permanent seabed impact of 0.0006 km^2, representing 0.000016% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC and 0.0000016% of the Southern North Sea SAC. Given the minimal scale of the footprint, the reburial evident in the immediate area and the expected recovery time (approximately two years), it is not expected that the structure of the sandbanks or the habitat of harbour porpoise prey will be affected by the proposed decommissioning activities, or that the conservation objectives of either SAC will be compromised if rock stabilisation is ultimately required. The slow release of the metals and plastics associated with the pipeline sand umbilical is also expected to have a negligible impact on the local environment.

Other projects contributing to the cumulative impact within the North Norfolk Sandbanks and Saturn Reef SAC and Southern North Sea SAC include a number of oil and gas and renewable developments. In combination with the Victoria P&A and decommissioning activities outlined herein, an anticipated 37.88 km^2 of each SAC is expected to be temporarily impacted. A total 0.73 km^2 of permanent impact is also expected. Overall, a cumulative 1.07% of the North Norfolk Sandbanks and Saturn Reef SAC and 0.1% of the Southern North Sea SAC is thought to be affected by current and future developments.

Due to the distance of the Victoria decommissioning from the UK/ Netherlands median line, approximately 45 km, no transboundary impacts are likely to occur as a result of the proposed decommissioning.

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 non-permitted 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. Due to safety concerns with MeOH, flushing of the MeOH cores to sea will be required along the length of the umbilical.

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). The DSV 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 pipeline contents will be validated during pressure testing and the pipeline 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 a maximum of 60 m^3 in the pipeline at 5 barg, to a maximum of 375 m^3 at sea level, where it will be rapidly dispersed by wind. The condensate phase released from the pipeline (anticipated to be a maximum of 0.6 m^3) will rise through the water column and will mostly vaporise as the pressure reduces from 5 barg at the seabed to atmospheric pressure at the surface. The latest OPEP (Fraser Well Management, 2020) has modelled the release of a pipeline contents of a slightly higher content of 0.821 m^3 of condensate (Section 9). Under this scenario, the amount of surface hydrocarbons became insignificant after 2 hours. At the end of the simulation, the model predicted that up to

66% of condensate would evaporate and that up to 21% (approximately 0.16 m^3) would be deposited on the sediment.

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.

A full Chemical Risk Assessment (CRA) will be carried out prior to decommissioning activities as part of the permitting process.

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 SAC.

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. The discharge of the pipeline fluids is also not expected to result in an impact to the qualifying features of the SAC.

Southern North Sea SAC (Figure 3.10) identified as an area of importance for harbour porpoise (*Phocoena phocena*) populations, an Annex II species (JNCC, 2018b). The harbour porpoise has been sighted within the Victoria decommissioning area (Quadrant 49) 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. The short-term release of contaminated fluids is unlikely to have an effect on the harbour porpoise and supporting habitat, or any other marine mammal in the vicinity. 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 low concentration 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	Pipeline will be flooded, flushed and pigged with seawater prior to decommissioning as will the MeOH cores within the umbilical. Contaminants remaining in the pipeline and umbilical are minimal (Sections 6.3.1 and 6.3.2) and are not expected to have a significant environmental impact. The pipeline contents will be validated during pressure testing All chemical release activities will be covered by the appropriate permits prior to flushing activities and in discussion with OPRED.
Release of contaminants from pipeline and umbilical over the long term	Following decommissioning, environmental monitoring surveys will be undertaken under an agreed schedule as per BEIS guidelines.

6.7 Conclusions

Flushing and flooding of the pipeline and umbilical will introduce chemical contaminants to the sediment and water column, but these are expected to be negligible amounts that will 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 expected to be negligible and is not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities. No significant impacts to the qualifying features or conservation objectives of the SACs are expected.

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 1-2) 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 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 and umbilicals 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. 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:

- DSV
- CSV
- Guard vessel;
- Rock vessel;
- Survey vessel; and
- Jack-up rig

The vessel spread and worst-case anticipated days per vessel type is provided in Appendix C.

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*. However, in the unlikely instance that this did happen, 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:

- Excavation at the pipeline ends to enable these to be severed from the seabed;
- Exposed sections of pipeline;
- Introduction of rock/ gravel substrate for rig stabilisation; and
- The crossing structure decommissioned *in situ*

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). A summary of the four historical surveys carried out between 2008 and 2013 is available in Appendix B.

The most recent 2021 survey data indicates that the pipeline and the umbilical continue to remain trenched below the seabed with typical burial depths of around 1.4 m (Appendix B). There are four exposures associated with the PLU2527 umbilical, none of which are spans. All four exposures are located within the mattress covered approach to the Victoria Valve Skid (Appendix B). This umbilical section will be removed during decommissioning activities.

Evidence from the 2021 survey also shows there are 17 areas of exposure along the pipeline (Appendix B; Table B3), however ten of these are located within the initial 106 m of the pipeline and are therefore associated with the mattress protected spools (i.e., mattress rather than pipeline exposure) and the pipeline trench transition section, indicating a certain amount of reburial at these locations. Given our intent that these spools and trench transition sections will be recovered along with their protective mattresses there is no risk of any future exposure. Of the remaining seven reported “pipeline” exposures, five are located within the AR crossing section and again relate to mattress rather than pipe exposure. For these five reported instances, a review of the video surveillance actually showed limited mattress exposure and where this was observed it related only to a few of the concrete segments rather than the whole mattress.

Of the last two remaining “pipeline” exposures, one was noted to be present within sandwave no. 6 (which will be cut out and recovered) and the other just prior to the AR crossing but limited to just the crown of pipe with no free-spanning (Appendix B). Based on a comparison between the 2008 and 2021 survey results it was also observed that the depth of cover associated with some sand waves has diminished significantly because of sand wave migration, resulting (as a worst case to date) in the pipe exposure within sandwave 6 (Appendix B).

During decommissioning, NEO intends to cut out and recover the pipeline and umbilical sections that are at risk of future exposure due to the effect of sand wave migration. These remedial actions primarily relate to removal of those pipeline and umbilical sections within sandwaves 5 and 6. However, in the event that other areas are encountered that do not meet the 0.6m burial criteria, then localised jetting will be employed to further lower the pipe and/or umbilical. NEO will not be using rock cover as remediation for future pipeline and umbilical exposures.
.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.

7.3.4 Impacts on Fishing Activities

Commercial fisheries data over the year has shown that the majority of fishing activity in the Victoria area is attributed to demersal and shellfish catch (Section 3.4). However, the relative fisheries value and landings for demersal fisheries in 2019 was relatively low (Table 3-8), indicating low fishing activity in the area.

Beam trawl was the main method of fishing in ICES rectangle 35F2 in 2019 (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. 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 inches), the potential for any strike between fishing gear and pipeline resulting in a vessel coming fast and in turn sinking, is negligible. Furthermore, recent survey data identified the pipeline and umbilical to be stably buried (with the exception of those “at risk” sections within the two most easterly sand waves and the AR pipeline crossing) to depths of around 1.4 m with no evidence of free-spans (Appendix B). The crossing section is protected using concrete mattresses, and visual evidence from the 2021 survey now shows such mattresses to be almost completely covered with sediment.

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). This is evidenced by the 2021 exposure associated with sandwave migration (Appendix B), as described above. Jetting and reburial activities will also be carried out following the flushing and flooding of PL2526. The increase in specific gravity of PL2526 following flooding will also potentially lead to increased burial depth over time.

The decommissioning activities may also result in some small seabed depressions resulting from the removal of the Victoria subsea infrastructure and the excavation of pipeline and umbilical ends. However, depressions associated with pile removal are expected to be small in diameter and 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). In sandy and highly mobile environments such as this, recovery would be expected to be at the lower end of this scale. Additionally, due to the sandy nature of the seabed sediments are likely to pass through fishing gear with relative ease compared to substrates such as clay, which more readily cause catch contamination and hold berms, thus presenting more of a snagging risk. As such it is not thought that these seabed features would constitute a snagging risk to fisheries.

NEO will remediate any areas of exposure prior to decommissioning by removal or reburial to >0.6 m depth and will ensure the pipeline and umbilical will be decommissioned in a state that leaves adequate sediment surface coverage over the top of the infrastructure. NEO will not be using rock cover as remediation for future pipeline and umbilical exposures.

Long-term impacts associated with the stabilisation of the drill rig (if required) are expected to create a maximum permanent seabed impact of 0.0006 km^2 with three (maximum) areas of gravel placed by a fall pipe in a smooth profile below each spud can, to prevent scour. During deposition of the gravel material, care will be taken to minimise the area of rock placement and to ensure as flat a profile as possible, to enable safe overtrawl. Pipeline survey video footage indicates that the mattresses in the Victoria Field became at least partially buried after two years. Given that any stabilisation gravel would be level with the seabed it would be expected that reburial and recovery would occur within two years. Given the minimal scale and flat profile of the footprint and the expected recovery time, it is not expected that there will be any snagging hazard for fisheries.

The short duration (maximum of 25 days) and time of year (summer) of operations should minimise the risk of scour and the requirement for rock placement, as seabed sediment movement would be expected to be minimal. Additionally, during decommissioning planning a study will be conducted to determine if the effects of scour can be mitigated through the rig selection process by considering the size, profile, design of spud cans and jack-up leg configurations. Thus, rock placement is not a planned activity and is considered a last resort should the effect of scour, if present, becomes unmanageable to the point that the safety of personnel or the integrity of the rig and well systems are compromised.

Post-decommissioning, a non-intrusive seabed clearance verification survey will ensure that the potential for interaction with fishing gear will be minimal. Ongoing inspections will be undertaken on a schedule to be confirmed alongside OPRED and particular attention will be paid to the areas identified of exposure and <0.6 m burial identified in the historical and recent burial studies.

7.3.5 Impacts on Commercial Shipping

As the PL2526 pipeline and PLU2527 umbilical are to be decommissioned *in situ* the only increase in vessel traffic will be associated with vessel movements associated with the removal of the spools and other infrastructure; this constitutes very temporary increased vessel presence. With respect to fishing activities, further potential impacts include the limited temporary loss of access to fishing grounds during decommissioning activities.

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.

7.3.6 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.

7.4 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.

7.5 Proposed Mitigation Measures

Proposed mitigation measures to minimise societal impacts are detailed in Table 7-1.

Table 7-1 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 verification survey in the wake of decommissioning activities 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 impacts of the physical presence of any rock/ gravel substrate introduced to the seabed	Study to be conducted to determine if the effects of scour can be mitigated through the rig selection process by considering the size, profile, design of spud cans and jack-up leg configurations. Controlled deposition of gravel Smooth (flat) profile
Long-term 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.

7.6 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 and the deposition of any rock/ gravel stabilisation (if required) in a flat, overtrawlable profile on the seabed.

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:

- DSV
- CSV
- Guard vessel
- Rock Vessel
- Survey vessel
- Pipeline cutting; and
- Well P&A with a jack-up drilling rig

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 Conservation of Offshore Marine Habitats and Species Regulations 2017 which superseded 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). The regulations 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, 2017g). 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, using dynamic positioning systems. 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. Only the valve skid structure is piled and these will be cut internally upon removal. The vessel noise, dominant sound source, is classed as a non-pulse noise source. Of note here is that the use of explosives will not be required 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 and wellhead 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 and wellhead cutting is expected to be internal (contained), 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.

8.4 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.

Popper *et al*. (2014) developed criteria for the onset of injury in fish in the ‘Sound Exposure Guidelines for Fishes and Sea Turtles’. The onset of injury due to a number of noise sources was identified and, where data allowed, quantified. For explosives, the radius of the zone for fatal injury to fish, using a peak pressure level of 229 – 234 dB re 1 μPa, will be between 150-250 m from the sound source. However, this is a considerable overestimate in the context of the Victoria decommissioning, during which vessel-related and continuous sound are more comparable to the proposed activities. In fish which both have and do not have swim bladders involved in hearing, even at distances in the tens of metres (considered ‘near’ the noise source), the potential for mortality is low and has not been quantified. However, there is a moderate to high chance that fish ‘near’ the sound source will alter their behaviour, which decreases with distance from the source (Popper *et al*., 2014).

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; Popper *et al*., 2014). Reactions include diving, horizontal movement and changes in tilt angle (De Robertis and Handegard, 2013).

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.

Overall, the proposed Victoria decommissioning activities are only likely to induce a temporary behavioural change in fish which are particularly ‘near’ any activities which are generating noise. These behavioural changes are short-term so once the noise generation ceases, and fish are expected to return to the area once decommissioning activities cease. The decommissioning will only have a very short-term effect on the availability of harbour porpoise prey within a highly localised area from which harbour porpoise themselves may avoid for the duration of the activities. These activities are not expected to impact the conservation objectives of the Southern North Sea SAC, which aims to maintain the condition of supporting habitats and processes, and the availability of prey for the harbour porpoise.

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, 2017g; 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 9 m (grey seal) 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).

The radii of impact are converted into areas and are used to calculate the percentage of the species population which will be affected by the noise generated during decommissioning. Table 8-3 shows the proportion of cetacean populations affected by disturbance due to the Victoria decommissioning.

Table 8-3 Estimated number of mammals experiencing a disturbance as a result of the Victoria decommissioning activities

Species	SCANS-III density estimates (per km^2) (Hammond *et al.*, 2021)	Maximum number of animals predicted to be in the disturbance impact zone at any one time (density x disturbance impact area)	Marine Mammal Management Unit Population (IAMMWG, 2015)	Percentage of reference population potentially affected
Minke whale	0.621	0.00050	23,528	2.12E-6
White-beaked dolphin	0.002	1.23E-6	15,895	7.75E-9
Harbour porpoise	0.888	0.025	227,298	1.11E-5
Density estimates are not available for the following cetacean species: long-finned pilot whale, bottlenose dolphin, common dolphin, and white-sided dolphin.				

Considering the percentage of the populations affected in Table 8-3 it is clear that a very small proportion (<0.1% for each species) could be affected over a very short period of time. For species not listed due to lack of available information (long-finned pilot whale, bottlenose dolphin, common dolphin, and white-sided dolphin), densities would be expected to be lower than those in Table 8-3, and the percentage of population affected would be lower. It is therefore concluded that whilst a small number of individual animals may exhibit some form of change in behaviour for the extremely short period of the decommissioning noise, this number would be largely undetectable within the context of the wider population.

Within the context of the Southern North Sea SAC, the Victoria decommissioning is unlikely to generate significant disturbance of harbour porpoise. As such, the activities are not thought to contravene the site's Conservation Objectives (as detailed in Table 3-7), and the integrity of the site will not be compromised.

8.5.2 Assessment using National Marine Fisheries Standards (2016 & 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 8-4 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 8-4 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 five platforms (four are Harbour Energy-operated, one is operated by Alpha Petroleum). Within 1 km of the PL2526 pipeline there are 7 wells, one skid and 22 pipelines. Of the infrastructure listed in Section 3.5, decommissioning of the Viking platforms and Viscount platform has concluded. Decommissioning of the Wenlock infrastructure (14.12 km NNW of Victoria) operated by Alpha Petroleum) is set to commence in 2023 (Alpha Petroleum, 2021), after decommissioning at Victoria is complete. As such, at the time of writing, there is no known overlap between the proposed Victoria decommissioning activities and any other such similar activities at other oil and gas developments.

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 number of proposed windfarm areas (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.

Of the proposed windfarms in the SNS, Hornsea 3, Norfolk Vanguard and Norfolk Boreas are currently in pre-planning stages and all are located within 50 km of Victoria. Piling activities associated with windfarm construction can have an impact on marine mammals.

The Victoria decommissioning is likely to conclude in 2022 (including P&A activities). The timelines for the Norfolk Boreas and Vanguard windfarms suggests that offshore construction will commence in the mid-2020s (Vattenfall, 2018, 2019). Subsequently, activities associated with these windfarms are unlikely to coincide with the proposed Victoria decommissioning. Hornsea 3 proposes onshore construction to commence in 2021, likely followed by offshore activities (Orsted, 2018a). Temporally, this also means it is highly unlikely that the windfarm construction and Victoria decommissioning activities will overlap. A study on subsea noise to be potentially generated during the development of Hornsea 3 lists that the most energetic monopiling activity (5,000 kJ) occurring in the south of the windfarm area (closest to Victoria) would generate a maximum range of impact of 20 km, out to which TTS could be expected to occur in LF cetaceans. This range is greatly reduced in MF and HF cetaceans (Orsted, 2018b). As Victoria lies 40 km from the Hornsea 3 site, spatial overlap between noise generated by the decommissioning and the construction of the windfarm is unlikely to occur, owing to the very limited and highly localised noise generated at Victoria. Noise generating activities associated with both projects will be intermittent and temporal overlap is also highly unlikely. Therefore, no cumulative impacts are likely to occur as a result of underwater noise generated during the Victoria decommissioning.

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 8-5.

Table 8-5 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 Timing of cutting activities will be planned to avoid cumulative noise impacts

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 (ALARP).

With regard to offshore decommissioning operations, potential sources of accidental spillage are:

- Condensate release from the Victoria well*;
- Condensate release from the Victoria pipeline;
- Fuel (diesel) release from any installation or vessel working on Victoria well or facilities; and
- Spillages of diesel fuel from any other vessels unconnected with Victoria but which are in the area (Fraser Well Management, 2020)

*It should be noted here that the Victoria well is no longer producing, is disconnected from the Viking infrastructure and is shut in, therefore the likelihood of a blowout is negligible.

9.1 Regulatory Context

The consequences of a potential hydrocarbon 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 hydrocarbon release occurring during the proposed decommissioning activities.

9.2.1 Sources of Potential Impacts

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. 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 expected to contain negligible amounts of condensate, 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

Diesel fuel and condensate have a very high proportion of volatile components, which evaporate quickly on release and don't form emulsions. The low asphaltene content in these fuels prevent emulsification, reducing their persistence in the marine environment. For the purposes of modelling the Victoria Condensate, a representative analogue (Sleipner) was chosen (Table 9-1).

Table 9-1 Hydrocarbon properties

Oil	API (°)	Specific Gravity	Pour point (°C)	Asphaltene content (% mass)	Wax content (% mass)
Victoria Condensate	62	0.733	<-40	0	0
OSCAR Analogue – Sleipner (Condensate)	58.4	0.745	-30	0	0
Marine Diesel	36.4	0.843	-36	0	0

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 (Fraser Well Management, 2020). 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.

Six 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).

For the diesel spills covered by scenarios T1a and T1b, the results suggest that no hydrocarbons would beach or cross the median line (on sea surface) before the end of the simulation (after 10 days) (Table 9-2). The amount of surface hydrocarbons became insignificant (<5% of oil content remaining at surface) after 8 and 9 hours, respectively (Table 9-3). At the end of the simulation, the model predicted 26% of diesel would evaporate and 48% and 47% would be deposited on the sediment for T1a and T1b scenarios, respectively.

For the well blowout covered by scenarios T2a and T2b, the results suggest that no hydrocarbons would beach or cross the median line (on sea surface) before the end of the simulation (after 130 days) (Table 9-2). The amount of surface hydrocarbons became insignificant after 4 hours for both scenarios (Table 9-3). At the end of the simulation, the model predicted that 61% and 64% of condensate would evaporate and 16% and 14% would be deposited on the sediment, respectively for T2a and T2b.

For the pipeline release covered by scenarios T3a and T3b, the results suggest that no hydrocarbons would beach or cross the median line (on sea surface) before the end of the simulation (after 10 days) (Table 9-2). The amount of surface hydrocarbons became insignificant after 2 hours for both scenarios (Table 9-3). At the end of the simulation, the model predicted that 59% and 66% of condensate would evaporate and 21% and 15% would be deposited on the sediment, respectively for T3a and T3b.

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
T2a: Blowout until well relief (Sleipner condensate)	170	2880(120)	0.059	130	40
T3a: Pipeline release (Sleipner condensate)	0.821	1(0)	0.821	10	40
Towards UK/Netherlands median line					
T1b: Diesel spill from vessels	667	1(0)	667	10	270
T2b: Blowout until well relief (Sleipner condensate)	170	2880(120)	0.059	130	270
T3b: Pipeline release (Sleipner condensate)	0.821	1(0)	0.821	10	270

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
T2: Blowout until well relief (Sleipner condensate)	N/A	N/A	4	4	N/A	N/A
T3: Pipeline release (Sleipner condensate)	N/A	N/A	2	2	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 surrounding seabed environment and water column if a spill were to occur (Table 9-4).

Table 9-4 Summary of potential impacts to main biological receptors

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	Cetaceans and seals are generally accepted to be able to avoid hydrocarbon spills. However, should contact occur, effects include irritation and respiratory problems. Hypothermia effects are generally avoided due to a thick layer of blubber.
Offshore protected habitats	Located within two SACs, an accidental release of hydrocarbons may not directly impact the qualifying features of the North Norfolk Sandbank and Saturn Reef SAC though there could be indirect impacts to *S. spinulosa* reef habitats. Though the harbour porpoise in the Southern North Sea SAC is susceptible hydrocarbons, they would likely avoid an area affected by a spill.
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.
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

According to the oil spill modelling presented here, the potential for a significant (>5% hydrocarbon content remaining) slick cross to the UK/ Netherlands median line or reach a coastline is highly unlikely. 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 (Fraser Well Management, 2020). 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

Potential source of impact	Planned mitigation measures
Well release	The Victoria well continues to be monitored by regular ROV general visual inspections (GVI), performed at a 24-month frequency. The last GVI was performed on 21st Jun 2019 and observed no anomalies. GVI activity is managed withing the FWM WIMS (Well Integrity Management System) with the next GVI scheduled for June 2021. Planning for this GVI is underway. Well integrity testing has not been performed since hydraulics controls were disconnected during the decommissioning on the Viking B platform, which until that point had controlled the well. Risk assessments have been completed for the well to remain shut-in without tree/valve testing until decommissioning. These risk assessments are managed by the FWM WIMS and are subject to scheduled reviews.
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 condensate spill occurring is low and is very unlikely 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 verified to ISO 14001: 2004 in 2014 and 2016. The biannual external verification will be completed in September 2018 to the ISO 14001:2015 standard.

There are a number of associated benefits with the installation EMS having ISO 14001 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 is committed to Net Zero and the OGA Stewardship Expectation 11. NEO's Strategy to reduce emissions is intended to drive increased energy efficiencies and reduced emissions. NEO plans several improvements under our Strategy including the release of a Low Carbon Transition Plan (LCTP), which reviews carbon intensity and emissions at asset level, identifies operational efficiencies (minimising flaring and venting, tackling methane emissions and smart decommissioning methods. NEO are also committed to collaboration with partners and industry associations to explore alternative power solutions, including full or partial electrification, and technology development.

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 ALARP.

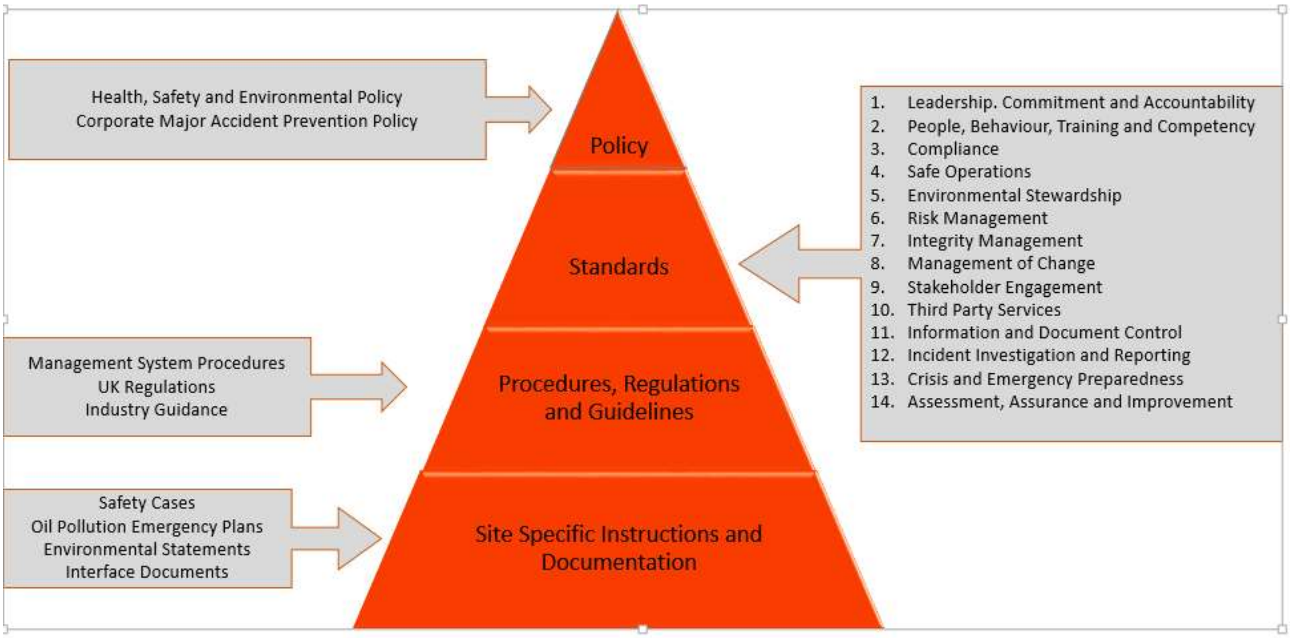

Figure 10-1 NEO HSE Management Framework

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 SAC, 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.

As part of the Victoria decommissioning, all subsea infrastructure will be fully removed with the exception of the pipeline and umbilical. NEO intends to decommission the PL2526 and PLU2527 *in situ*. The pipeline and umbilical ends will be cut and removed. Any exposed sections of pipework and umbilical, along with the cut ends, will be removed and backfilled. Mattresses and grout bags will be fully removed where safe to do so, with the exception of those associated with the AR crossing and those protecting the umbilical whilst at full trench depth prior to the start of the trench transition at Victoria. Where this is not possible, NEO will refer to OPRED to discuss the technical and/ or safety issues associated with these operations. NEO will ensure that, per industry guidance, the seabed will be left clear, 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).

The proposed excavation, cutting, and item removal activities will physically disturb the sediment in the local area (Section 5). The seabed sediment disturbance will be temporary, localised and confined to an estimated area of, approximately, 0.007 km^2. This represents 0.00019% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC (3,603 km^2; JNCC, 2017c) and 0.000019% of the total area of the Southern North Sea SAC (36,951 km^2; JNCC, 2017d). Removal of exposed (and potential future exposures) pipeline and umbilical sections, and the decommissioning of the remaining pipeline and umbilical infrastructure in situ will minimise the disturbance to the environment and hence should have little or no impact on sandwave morphology. Temporary seabed impacts are expected to be short-term and not significantly impact the conservation features of either SAC. Given the dynamic seabed conditions, re-burial and recovery of the surface seabed and associated fauna is expected to take approximately one year.

Given the shallow depth of the seabed, large areas of the SNS are unsuitable for the use of semi-submersible vessels (DECC, 2015). A jack-up rig is therefore the only suitable technology that can be utilised for the removal of the Victoria integrated WHPS and will be placed adjacent to the Victoria wellhead during decommissioning operations. Following the placement of the spudcans on the seabed, it is possible that gravel stabilisation material may be required to prevent scour and help stabilise the rig. Every endeavour will be made to avoid this requirement, including pre-loading of the rig to simulate maximum loads, frequent ROV inspections, re-levelling of the rig and re-positioning of the spudcans.

Of two previous rig placements at the same location, one recorded incident of scour occurred after 17 days of a 45-day operation in 2008. Mitigation measures included re-levelling of the rig, however, after 24 days, rig settlement was outwith acceptable operational limits and gravel was placed over the spudcans. As the planned duration of the Victoria well decommissioning scope is 20 days it is unlikely that scour mitigation will be required.

In the unlikely scenario that stabilisation is required, the placement of 3,000 Te of gravel would create some permanent, yet recoverable, disturbance of seabed sediments, over an estimated area of 0.0006 km^2, representing 0.000016% of the total area of the North Norfolk Sandbanks and Saturn Reef SAC and 0.0000016% of the Southern North Sea SAC. Gravel would be carefully placed with a flat profile and given the dynamic seabed conditions in this area of the SNS, reburial and recovery of the surface seabed and associated fauna is expected to take a maximum of two years, in line with observed mattress reburial in the vicinity of the WHPS. MBES survey data (ODE Asset Management, 2021) from the area directly adjacent to the WHPS also shows no indication of the gravel placed on the spudcans during the 2008 campaign, suggesting reburial. As such, although the introduction of stabilisation material into the SACs would be a permanent addition of hard substrate, it is expected that the seabed would recover and it is not expected that any conservation objectives pertaining to the structure of the sandbanks or the habitat of harbour porpoise prey will be compromised by the proposed well decommissioning activities.

The decommissioning of the pipeline and umbilical *in situ* and the potential introduction of rock substrate to the seabed, is unlikely to have a significant impact on other sea users (i.e. fishing) or the integrity of sandwaves as a result of burial below 0.6 m and removal of any exposed sections (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 and/ or cutting noise associated with pile and wellhead cutting activities 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).

Decommissioning activities will have little or no impact on the qualifying features or conservation objectives of the North Norfolk Sandbank and Saturn Reef SAC and Southern North Sea SAC. Seabed disturbance may result in changes to sandbanks and supporting habitat of harbour porpoise, but disturbed areas will recover quickly due to the currents and tidal characteristics of the area. The recovery of benthic communities should also be relatively rapid.

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 A 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.
	The Offshore Petroleum Production and Pipelines	These Regulations implement the EIA Directive with regard to the offshore oil and gas industry. The Regulations require an EIA and the

Regulator	Legislation	Summary of requirement
	(Assessment of Environmental Effects) Regulations 1999 as amended (2007)	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 pipe-line 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 emissions by 2010 and thereafter not to exceed the amounts specified in the Schedule of that pollutant.

Regulator	Legislation	Summary of requirements
	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 time-frame 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 Environmental liability

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. Licence conditions will include environmental issues e.g. time constraints in sensitive areas. The model clauses of the licence 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 B Pipeline Burial Status

Five surveys of the Victoria pipeline have been carried out between 2008 and 2021, with the 2008, 2013 and 2021 surveys covered majority of the pipeline and umbilical length. The original installation records provide an indication of the depth of cover along the entire length of the production flowline and umbilical following their installation in 2008. Surveys carried out in 2009 and 2012 covered, approximately, 900 m of pipeline only from the Victoria valve skid, and only depth of cover profiles and ROV logs were collected. For the 2013 survey, there are no depth of cover profiles available, only videos and ROV logs for most of the pipeline and umbilical, from the Victoria valve skid to Viking 500 m safety zone. For the 2013 survey, there are no available depth of cover profile data, only video footage and side scan sonar image. The latest 2021 survey included Multibeam Echo Sounder (MBES) data and video footage of the entire pipeline and umbilical length. A summary of the surveys completed along the pipeline PL2526 and umbilical PLU2527 is provided in Table A3.1.

Table B 1 Available survey data for PL2526 and PLU2527

Survey year	Surveyed range	Installation	Total surveyed distance (m)
2008	KP 0.000 to KP 3.742	PL2526	3,742
	KP 0.074 to KP 3.921	PLU2527	3,847
2009	KP 0.000 to KP 0.892	PL2526	892
2012	KP 0.005 to KP 0.915	PL2526	910
2013	KP 0.000 to KP 3.014	PL2526 & PLU2527	3,014
2021	KP 0.000 to KP 3.742	PL2526 & PLU2527	3,742

B.1 Historic Survey Results

B.1.1 2008 Depth of Cover Survey

The 2008 post-installation survey (Canyon, 2008) indicates that the pipeline (PL2526) and umbilical (PLU2527) were buried below 1 m target burial depth for the majority of their lengths. Burial was only less than 0.6 m depth of cover towards the trench transitions at either end of the pipeline and umbilical. The data analysis from this survey shows that achieved depth of cover for pipeline and umbilical differed along the entire surveyed length, with the pipeline being generally buried deeper than the umbilical.

B.1.2 2009 and 2012 Pipeline Depth of Cover Surveys

The 2009 survey was completed over the first 892 m of the pipeline and the 2012 survey over first 910 m of the pipeline, starting at the Victoria valve skid end. A comparison between the 2009 and 2012 datasets along the pipeline extent is provided in Figure B-1. The figure illustrates depth of cover (DOC) and areas of exposed pipeline. The analysis clearly shows that, for the available data, the pipeline typically remained buried over the three-year period.

A single 1.94m span was reported in 2012. The comparison of corresponding seabed profiles in 2009 and 2012 allowed confirmation of the seabed mobility; in particular, sand wave migration is evidenced by the reduction in trough depth and increase in crest height between KP 0.6 and 0.9 from 2009 to 2012.

B.1.3 2013 Video and Multibeam Survey Data

The interrogation of the suite of ROV imagery data for the 2013 survey (BMT, 2018) indicated the majority of the pipeline remained buried over the entire 3km surveyed length. Where exposed, 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 allowed, these appeared 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 a non-reportable span presented in the 2012 data. The 2013 data showed the absence of this span, indicating the possibility of a data error in 2012. These can be caused if the ROV veers off track during the survey often a result of navigational glitches or strong tidal currents.

Despite the absence of DOC data for 2013 survey, it was concluded from the multibeam bathymetry image of the surveyed route that the entire pipeline and umbilical remained buried.

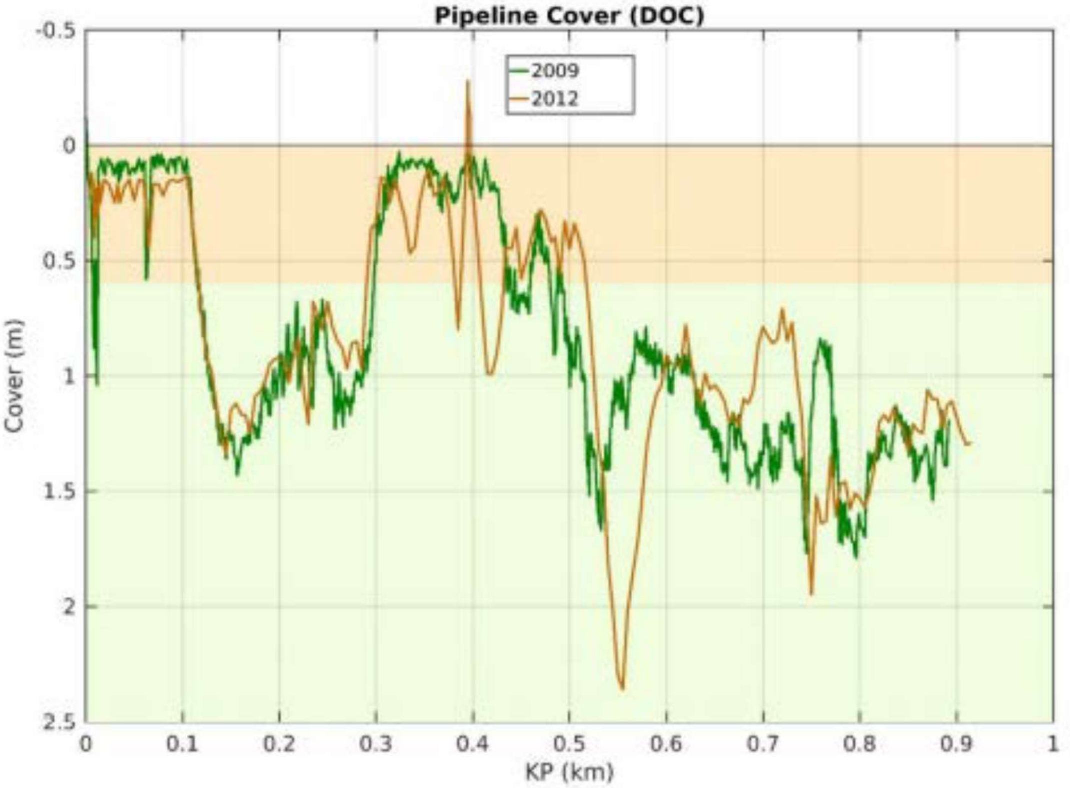


Figure B 1 Pipeline as-buried Depth of Cover (under 0.6m)

B.2 2021 Survey Results

B.2.1 Pipeline Depth of Burial

Results of the survey carried out by Fugro in April 2021 shows that, outwith the tie-in spools, trench transitions and the AR pipeline crossing, the Victoria pipeline remains mostly buried throughout its length with cover depths generally exceeding 1.4m, as illustrated within Table B-2.

Table B 2 Pipeline Burial Depth

KP	Easting	Northing	DOC	DOL
0.045	452610.67	5924055.72	0.78	0.79
0.055	452616.77	5924047.80	1.21	1.33
0.100	452644.41	5924012.29	1.53	1.50
0.250	452736.04	5923893.53	1.71	1.63
0.500	452891.62	5923697.92	0.97	0.95
0.750	453071.41	5923524.47	1.63	1.60
1.000	453269.52	5923372.15	1.25	1.07
1.250	453486.75	5923248.64	1.48	1.45
1.500	453714.41	5923145.41	1.44	1.41
1.750	453941.08	5923040.03	1.53	1.47
2.000	454169.99	5922939.76	1.50	1.40
2.250	454399.08	5922839.57	0.85	0.77
2.500	454639.41	5922771.05	1.50	1.37
2.750	454887.71	5922744.95	1.23	1.19
3.000	455137.68	5922746.34	1.72	1.66
3.250	455387.62	5922742.29	1.19	1.24
3.500	455616.86	5922647.72	0.67	0.49
3.700	455726.18	5922494.01	0.92	1.05

A total of 17 pipeline “exposure” anomalies were identified by MBES. With the start of the survey being at the first spool bend from the Victoria valve skid, the first 10 of these were located over the initial 106m section (i.e. between KP -0.072 and KP 0.034); and are therefore sited within either the tie-in spools or the trench transition all of which are mattress protected. Thereafter, no other “exposure” anomalies were identified until KP3.097 whereupon the following was noted (Table B-3).

Table B 3 Pipeline Burial Anomalies

From KP	To KP	Length of Exposure	Anomaly No.	Exposure Confirmed by Video	Comments
3.097	3.116	19.9 m	11	Yes – top of pipe only	Pipe exposure within sand wave No.6
3.367	3.377	9.6 m	12	Yes – top of pipe only	Pipe exposure just prior to start of trench transition at AR Pipeline Crossing
3.419	3.431	11.4 m	13	No video evidence of pipe or mat exposure	Within AR Pipeline Crossing Arrangement
3.436	3.439	2.6 m	14	No video evidence of pipe or mat exposure	Within AR Pipeline Crossing Arrangement
3.444	3.455	10.3 m	15	No video evidence of pipe or mat exposure	Within AR Pipeline Crossing Arrangement
3.461	3.463	1.9 m	17	No video evidence of pipe or mat exposure	Within AR Pipeline Crossing Arrangement
3.539	3.543	4.1 m	18	Video evidence shows partial exposure of a concrete mattress	This section is still within the trench transition of the AR crossing

From the above, it can be seen that the first exposure (anomaly 11) occurs just after the crest of a sand wave 6 (see Section B.3). By inspection of the as-built AR crossing coordinates, it is seen that the next exposure (anomaly 12) occurs as the route approaches the AR pipeline crossing but just before the start of the trench transition at KP3.385. The following 2 reported exposures (anomalies 13 & 14) occur after the end of the trench transition but before the actual AR crossing point. The next reported exposure (anomaly 15) occurs at or near to the point of crossing, followed by another (anomaly 17) prior to the start of the trench transition. The last exposure (anomaly 18) would seem to be within the trench transition.

Viewing of the video records show that for these 7 anomalies.

1. There is only pipe exposure at anomalies 11 & 12, and this is limited to just top of pipe with no evidence of free spanning.
2. Anomalies 13, 14, 15 and 17 all occur within the AR crossing configuration (inclusive of associated trench transitions) and the video evidence shows that all mattresses present are now buried
3. Anomaly 18 which shows partial exposure of some of the protection mattresses.

Several sections were also identified along the pipeline route where depth of cover was noted (by MBES) to be less than 0.6 m (Table B-4).

Table B 4 Pipeline DOC<0.6m

From KP	To KP	Length of Section	DOC within Section	Comments
2.630	2.650	20 m	DOC still remains > 0.49 m	Occurs with sand wave 5
3.075	3.130	55 m	DOC varies from 0.56 m to pipe exposure	Occurs within sand wave 6. Includes a 20 m exposed section (anomaly 11)
3.275	3.400	125 m	DOC varies from 0.40 m to pipe exposure	Occurs just prior to trench transition at approach to AR pipeline crossing. Includes a 10 m exposed section (anomaly 12)
3.420	3.485	65 m	DOC varies from 0.56 m to mat exposure	Section forms part of AR crossing configuration with exposure relating to partial exposure of mat segments rather than pipe
3.535	3.545	10 m	DOC varies from 0.26 m to mat exposure	Within AR crossing configuration. Exposure relates to partial exposure of mat segments rather than pipe.

From the above and excluding spools, trench transitions and the AR pipeline crossing arrangement, only three sections of the pipeline have been shown to have a DOC less than 0.6m, these being:

1. A 20m section (between KP 2.630 & KP 2.650) as existing within a sand wave (see Section B.3). MBES data showed minimum DOC to be 0.49m within this relatively short section.
2. A 55m section (between KP 3.075 & KP 3.130) as existing within Sand Wave No. 6 (see Section 4.4) and inclusive of a circa 15m exposed pipe segment. Video surveillance confirmed such exposure to be limited to the crown of the pipe (anomaly 11) with no evidence of any pipeline free spanning.
3. A 105m section (between KP 3.275 & KP 3.380) occurring just prior to the start of the trench transition at the AR crossing location and inclusive of a relatively short <10m exposed pipe segment. Video surveillance again showed such exposure to be limited to just the crown of the pipe (anomaly 12) with no evidence of any pipeline free spanning.

B.2.2 Umbilical Depth of Burial

Outwith the immediate approaches to the valve skids, the trench transitions and the AR pipeline crossing, the Victoria umbilical remains mostly buried throughout its length with cover depths typically exceeding 1.3m, as illustrated in Table B-5.

Table B 5 Umbilical burial depth

KP	Easting	Northing	DOC (m)	DOL (m)
0.100	452599.39	5924100.18	0.16	0.39
0.135	452621.91	5924073.68	0.75	0.70
0.250	452691.48	5923982.17	1.40	1.26
0.500	452843.10	5923783.47	1.30	1.27
0.750	453014.96	5923604.95	1.59	1.56
1.000	453206.33	5923444.53	1.67	1.62
1.250	453414.96	5923307.42	1.69	1.68
1.500	453639.28	5923196.91	1.55	1.52
1.750	453866.72	5923093.23	1.61	1.57
2.000	454097.42	5922997.15	1.59	1.47
2.250	454324.85	5922893.29	1.42	1.48
2.500	454559.54	5922808.44	1.75	1.76
2.750	454806.20	5922769.53	0.90	0.84
3.000	455056.08	5922765.30	1.38	1.36
3.250	455305.99	5922763.06	1.34	1.22
3.500	455543.61	5922718.60	0.66	0.64
3.750	455722.43	5922557.31	1.30	1.27
3.800	455744.10	5922512.27	1.25	1.22
3.825	455746.91	5922487.79	0.75	0.82

A total of 4 umbilical “exposure” anomalies were identified by MBES data. All of these were located at the Victoria end, either within the trench transition or the approach to the valve skid (Table B-6). Two umbilical sections have a DOC less than 0.6m, these being between KP2.725 & KP2.735 and between KP3.170 – KP3.220, both within sand waves

Table B 6 Umbilical Exposures

From KP	To KP	Length of Exposure	Anomaly No.	Comments
0.023	0.027	3.84 m	1	Site within the mattressed approach to the Victoria Valve Skid
0.064	0.065	0.83 m	2	Site within the mattressed approach to the Victoria Valve Skid
0.069	0.070	1.4 m	3	Site within the mattressed approach to the Victoria Valve Skid
0.117	0.121	3.9 m	4	Site within the mattressed trench transition zone

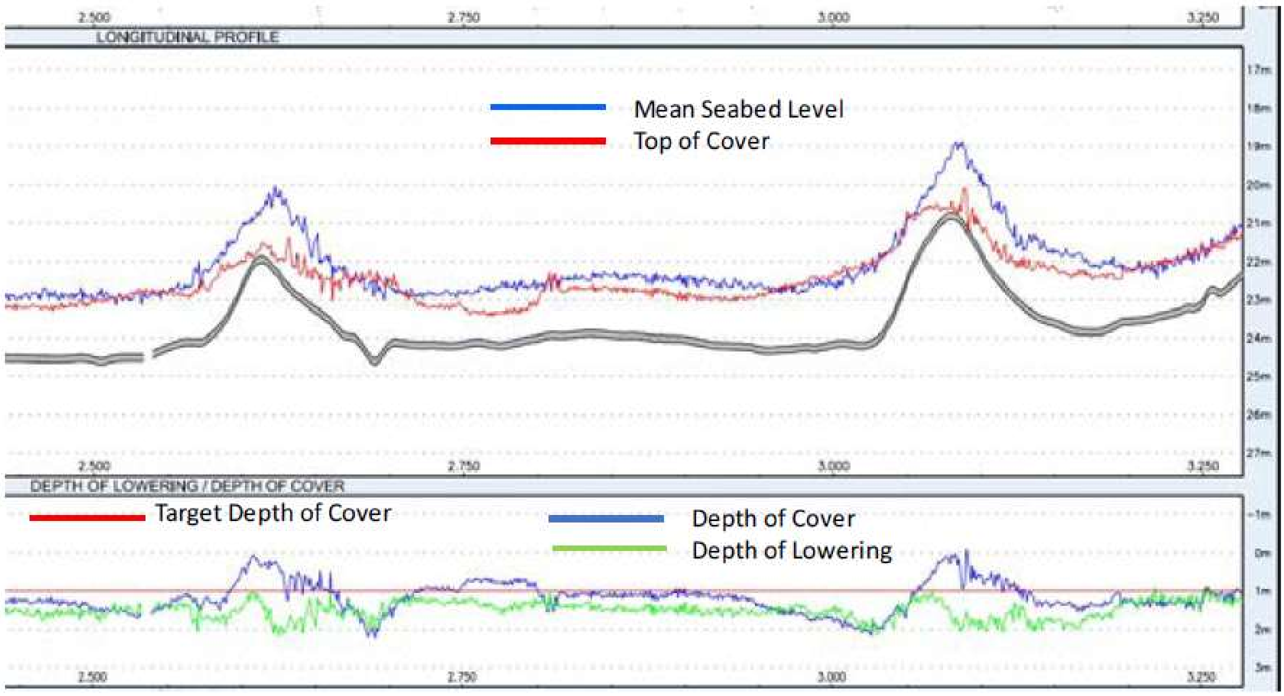
B.2.3 AR Pipeline Crossing Depth of Burial

Video footage over the crossing region confirmed that the protective mattresses within the trench transitions and at the crossing location to be predominately buried, albeit with a limited few showing exposure of some of their block segments. There was no video evidence of any pipe or umbilical exposure.

B.3 Sand Waves

Observations made during the 2008 and 2021 surveys showed sand waves to be present at 6 distinct locations along the route. For illustration purposes, the two most easterly for the pipeline (2008 survey data) are shown in Figure B-2. For each of the six 2008 wave profiles the top of the trenched pipeline remained well below mean seabed level. However, it was noted that for waves 5 & 6 the DOC for both pipeline and umbilical did diminish significantly, especially at or near to the wave crest. Similar observations were also noted during the 2021 survey with wave 6 actually now showing top of pipeline exposure. It is reasonable to assume that the cause of such exposure is as a result of sand wave migration. When comparing wave crest positions in relation to the pipeline KPs, it is noted that the sand waves have migrated up to 30m towards the west over the past 13 years.

Figure B 2 2008 Pipeline Trenching Profile (KP 2.50 to KP 3.25)



B.4 2008 to 2021 DOC Comparison

As shown by the following two graphs, since the pipeline and umbilical were first trenched in 2008 the DOC has significantly increased by natural sediment infilling over time (Figure B-3 and Figure B-4).

Figure B 3 Pipeline DOC for 2008 and 2021

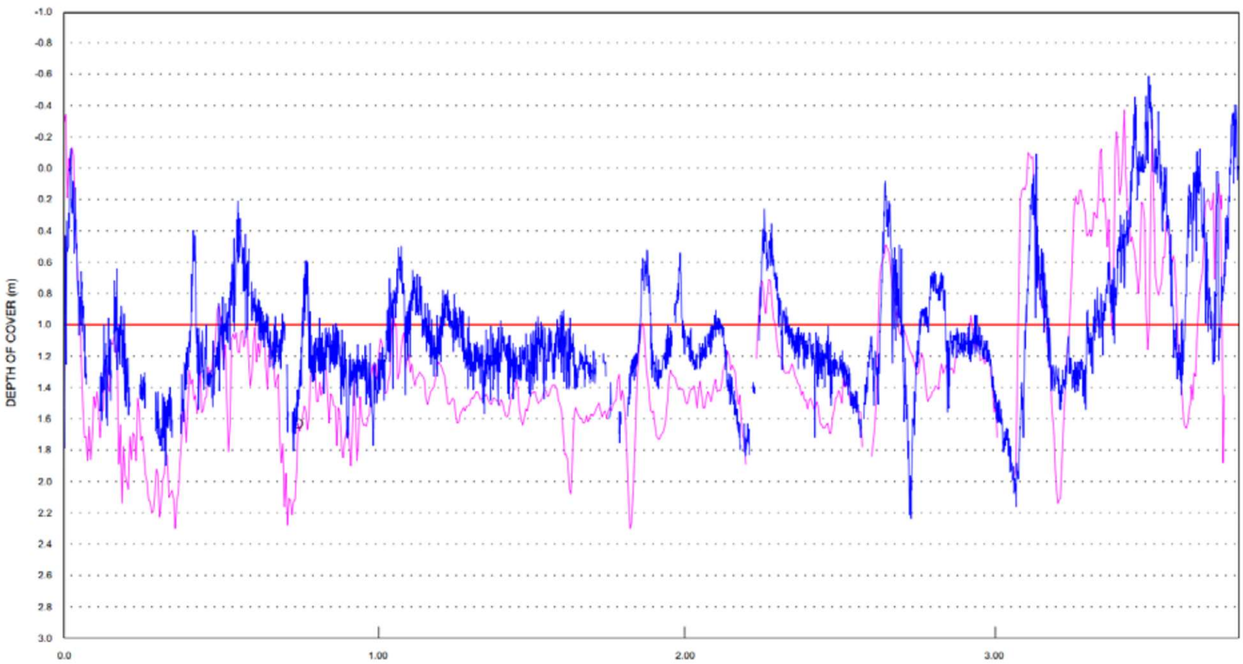
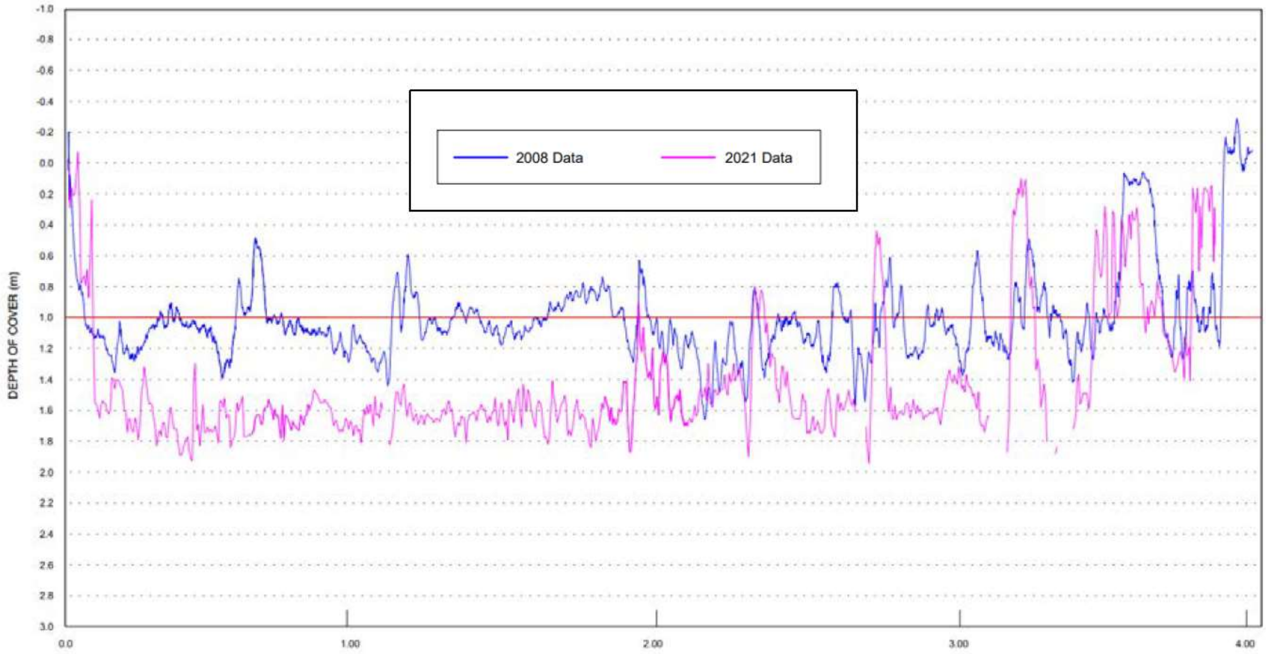


Figure B 4 Umbilical DOC for 2008 and 2021



B.5 Summary

B.5.1 Pipeline Burial

DOC analysis of PL2526 has shown that the vast majority of the pipeline length has continued to remain buried between years 2008 and 2021 with the latest survey showing just three trenched sections that have little or no soil cover:

- A 20m pipeline section between KP 2.630 and KP 2.650 coincident with sand wave 5. However, MBES data shows that DOC still remains > 0.49m over this relatively short section.
- A 55m pipeline section between KP 3.075 and KP 3.130 coincident with sand wave 6. Unfortunately, MBES data shows that DOC is generally less than 0.2m over this section. Video evidence also confirms the existence of a circa 19m exposed section between KP 3.097 and KP 3.116. These exposures can be attributed to the migration of the sand wave approximately 70 m to the west over the 13 years since installation in 2008.
- A 105m pipeline section between KP 3.275 and KP 3.380 occurring just prior to the start of the trench transition at the AR crossing location. With the exception of an exposed section, the MBES data shows DOC between 0.44 & 0.14m. Video evidence also confirms the existence of a circa 10m exposed section (top of pipe only) between KP 3.367 and KP 3.377.

B.5.1 Umbilical Burial

Similar to the pipeline, the DOC assessment has also shown that the umbilical has continued to remain substantially buried between years 2008 and 2021 with the latest survey showing just two sections outwith the mattressed AR crossing location having a soil cover less than 0.6m:

- A 10m umbilical section between KP 2.725 and KP 2.735 coincident with sand wave 5. However, MBES data from the 2021 survey shows that DOC still remains > 0.44m over this short section.
- A 50m umbilical section between KP 3.170 and KP 3.220 coincident with a sand wave. Although there is no actual exposure of the umbilical, MBES data shows that, in this instance, the DOC is generally less than 0.3m over this section. Such diminished values are again thought to have been caused by migration of the sand wave post installation.

B.6 Recommendations

On the basis of the evidence available it would suggest that the placement of protective material, the pipeline and umbilical orientation in relation to the migrating bedforms and the original pipeline and umbilical burial depth were sufficient to ensure the assets have remained mostly buried over the 13-year period. Given such a timescale, it is therefore reasonable to assume that the pipeline and umbilical will continue to remain buried within the sandwave migration rates for the foreseeable future, with the exception of sandwave 6 and sandwave 5. Figures B-5 and B-6 provide an overview of the six identified sandwaves and estimates their potential future movement in relation to pipeline and umbilical burial status.

For this reason, the following is recommended:

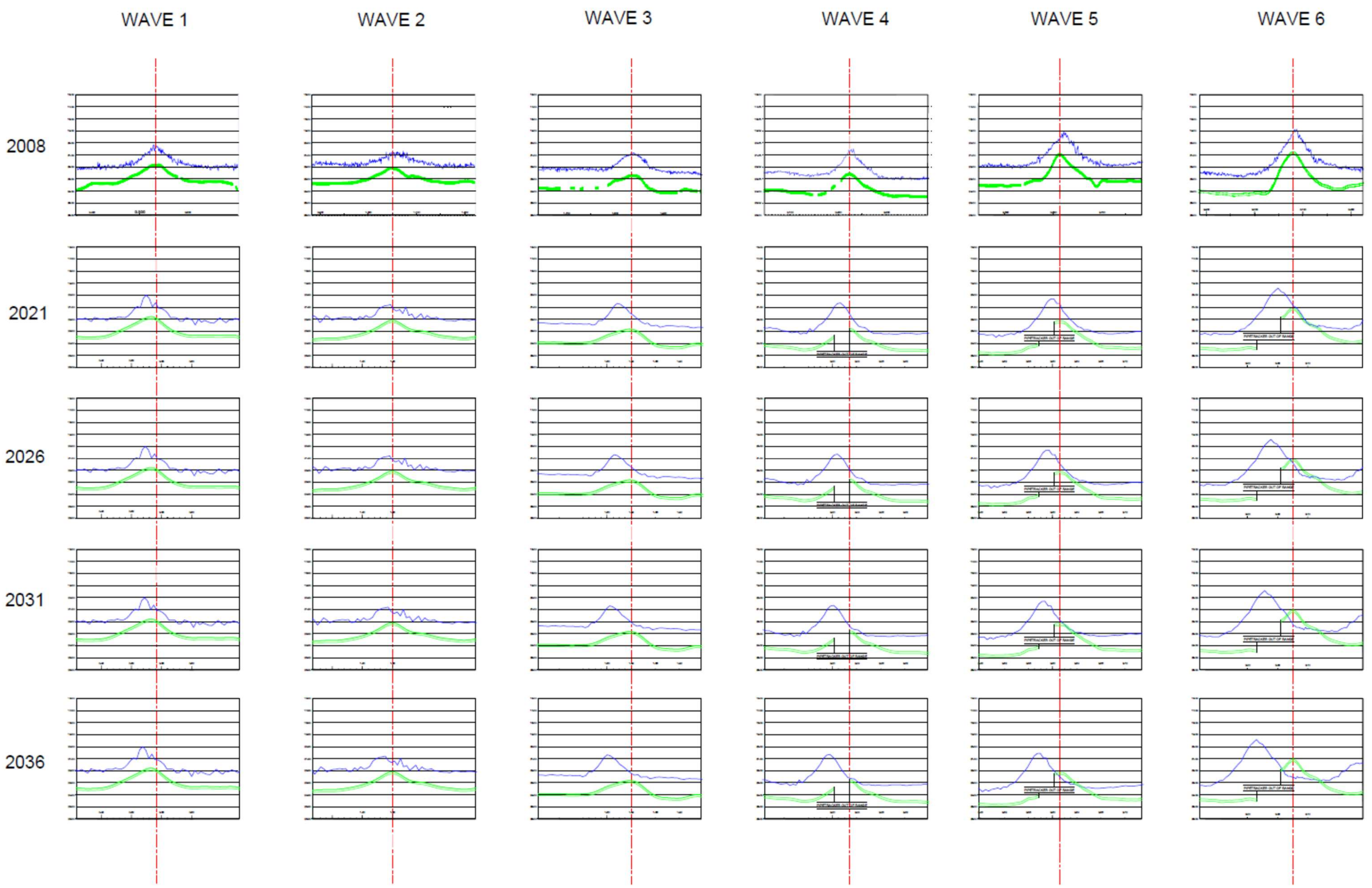
- The pipeline section between KP 2.630 and KP 2.650 (i.e. within Sand Wave 5) be cut and removed with pipeline ends re-buried.
- The pipeline be cut and removed between KP 3.075 and KP 3.130 (i.e. within sand wave 6) with pipeline ends re-buried. Such action should help to mitigate against the potential for future exposure due to further sand wave migration.
- The pipeline section between KP 3.275 and KP 3.380 be left as is, even though the DOC is less than 0.6m and there is some pipe exposure. The reasoning behind such a recommendation is the desire to minimise disruption to the environment wherever possible coupled with the believe that the current burial status is unlikely to worsen within the foreseeable future as this section of pipeline is not within the proximity of a sand wave.

  The exposed section is <10m in length and occurs only at the very top of pipe with no evidence of any free-spans. Such exposure would present little or no risk to fishing activities.

  The decommissioned pipeline will have an increased submerged weight due to being water rather than gas filled and thus be less susceptible to floatation within the soil cover if soil liquefaction were to occur from the effect of storm waves.
- The umbilical section between KP 2.725 and KP 2.735 (i.e. within sand wave 5) be cut and removed with ends re-buried.
- The umbilical be jetted/dredged between KP 3.170 and KP 3.240 (within sand wave 6) with ends re-buried. Such action should help to mitigate against the potential for future exposure due to further sand wave migration.

The pipeline and umbilical continue to remain buried with reasonable soil cover at the remaining four sand wave locations (Figure 5-2 B5 and B6). Any future exposure at these four locations will be identified during planned inspection activities and remediation will be removal or reburial to >0.6 m depth.

Figure B 5 Victoria sandwave migration pipeline predictions



SAND WAVE MIGRATION PREDICTIONS						
SAND WAVE NUMBER	1	2	3	4	5	6
PIPELINE CREST POSITION (KP)	0.535	1.050	1.835	2.235	2.615	3.075
2008 WAVE CREST POSITION (KP)	0.530	1.050	1.835	2.225	2.620	3.080
2021 WAVE CREST POSITION (KP)	0.525	1.045	1.820	2..210	2.600	3.050
WAVE MIGRATION TO THE WEST OVER 13 YEARS	5m	5m	15m	15m	20m	30m
WAVE MIGRATION PER YEAR TO THE WEST	0.38m	0.38m	1.15m	1.15m	1.54m	2.31m
PREDICTED 2026 WAVE CREST POSITION (KP)	0.523	1.043	1.814	2.204	2.592	3.038
PREDICTED 2031 WAVE CREST POSITION (KP)	0.521	1.041	1.808	2.198	2.585	3.027
PREDICTED 2036 WAVE CREST POSITION (KP)	0.519	1.039	1.803	2.193	2.577	3.015

NOTES:

1. KP values for "Pipeline Crest Position" taken from 2021 MBES survey data based on shallowest water depth at Top of Pipe (TOP) e.g. for Sand Wave 6 shallowest water depth for TOP is 21.03m occurring at KP 3.075
2. KP values for "2008 Wave Crest Position" scaled from 2008 pipeline survey charts e.g. for Sand Wave 6 wave crest is shown occurring at KP 3.050
3. KP values for "2021 Wave Crest Position" taken from 2021 MBES survey data based on shallowest water depth at seabed level e.g. for Sand Wave 6 shallowest water depth for MSBL is 19.7m occurring at KP 3.050

REVISION HISTORY

REV	DATE	DESCRIPTION	DRN	CHK'D	APP'D	CLIENT APP'D
0.1	28.07.21	ISSUED FOR CLIENT REVIEW	K.H	G.G	S.P	

PETREX DEVELOPMENTS

THIRD ANGLE PROJECTION

CLIENT: NEO ENERGY

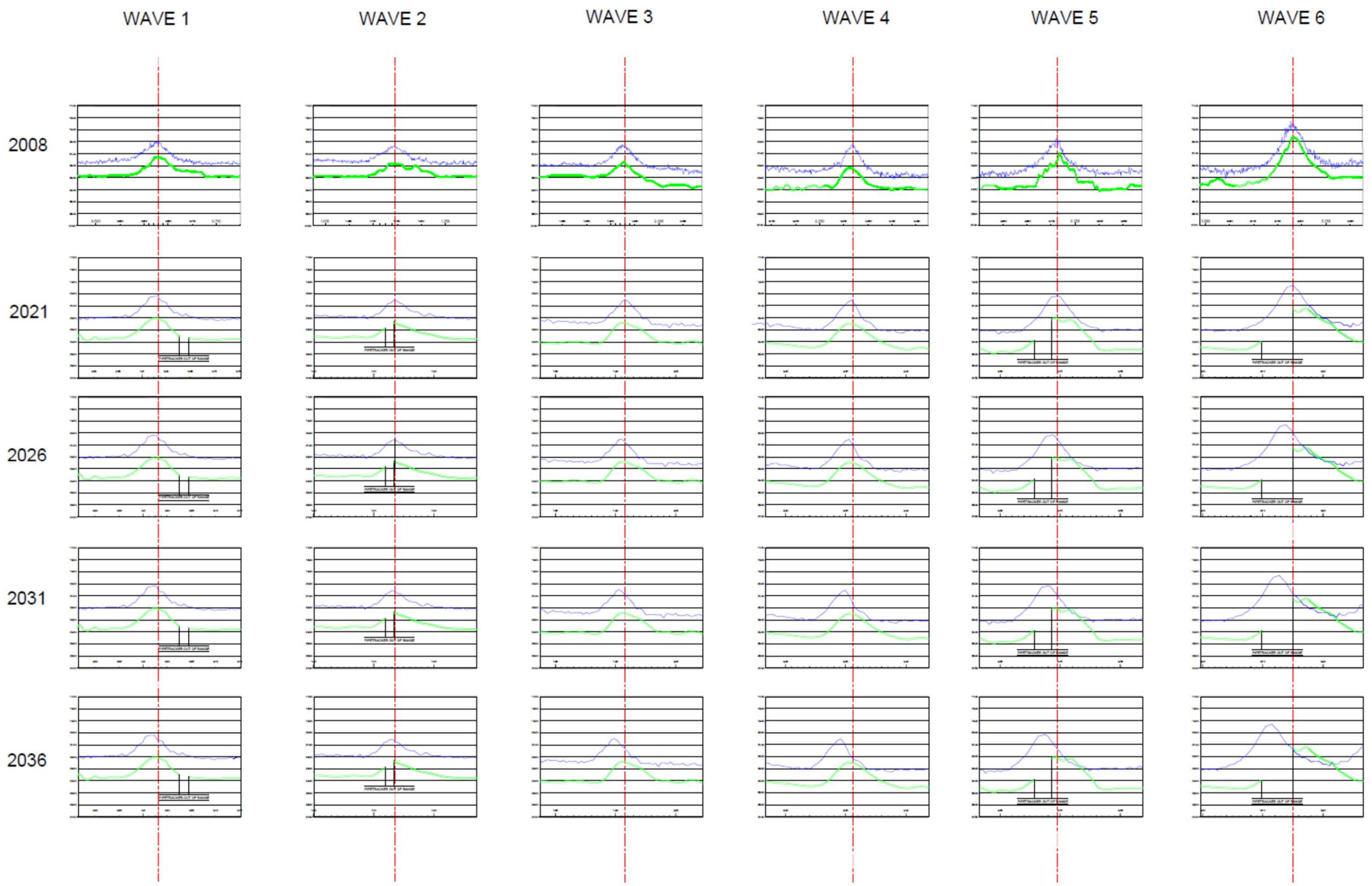
CLIENT DRAWING NO.

PROJECT: VICTORIA FIELD DEVELOPMENT

TITLE: PIPELINE BURIAL STATUS VERSUS SAND WAVE MIGRATION PREDICTIONS

SIZE	SCALE	DRAWING No.	REV
A1	N.T.S		0.1

Figure B 6 Victoria sandwave migration umbilical predictions



NOTES:

1. KP VALUES FOR "UMBILICAL CREST POSITION" TAKEN FROM 2021 MBES SURVEY DATA BASED ON SHALLOWEST WATER DEPTH AT TOP OF PIPE (TOP) E.G. FOR SAND WAVE 6 SHALLOWEST WATER DEPTH FOR TOP IS 21.14M OCCURRING AT KP 3.170

2. KP VALUES FOR "2008 WAVE CREST POSITION" SCALED FROM 2008 UMBILICAL SURVEY CHARTS E.G. FOR SAND WAVE 6 WAVE CREST IS SHOWN OCCURRING AT KP 3.180

3. KP VALUES FOR "2021 WAVE CREST POSITION" TAKEN FROM 2021 MBES SURVEY DATA BASED ON SHALLOWEST WATER DEPTH AT SEABED LEVEL E.G. FOR SAND WAVE 6 SHALLOWEST WATER DEPTH FOR MSBL IS 19.3M OCCURRING AT KP 3.150

SAND WAVE MIGRATION PREDICTIONS

SAND WAVE NUMBER	1	2	3	4	5	6
UMBILICAL CREST POSITION (KP)	0.625	1.130	1.910	2.305	2.690	3.170
2008 WAVE CREST POSITION (KP)	0.630	1.140	1.930	2.325	2.715	3.180
2021 WAVE CREST POSITION (KP)	0.625	1.135	1.915	2.310	2.695	3.150
WAVE MIGRATION TO THE WEST OVER 13 YEARS	5m	5m	15m	20m	20m	30m
WAVE MIGRATION PER YEAR TO THE WEST	0.38m	0.38m	1.15m	1.15m	1.54m	2.31m
PREDICTED 2026 WAVE CREST POSITION (KP)	0.623	1.133	1.909	2..304	2.687	3.138
PREDICTED 2031 WAVE CREST POSITION (KP)	0.621	1.131	1.904	2.298	2.680	3.127
PREDICTED 2036 WAVE CREST POSITION (KP)	0.619	1.129	1.898	2.293	2.673	3.115

REVISION HISTORY

REV	DATE	DESCRIPTION	DRN	CHK'D	APPD	CLIENT APPD
0.1	28.07.21	ISSUED FOR CLIENT REVIEW	K.H	G.G	S.F	

PETREX DEVELOPMENTS

THIRD ANGLE PROJECTION

CLIENT: NEO ENERGY

CLIENT DRAWING NO.

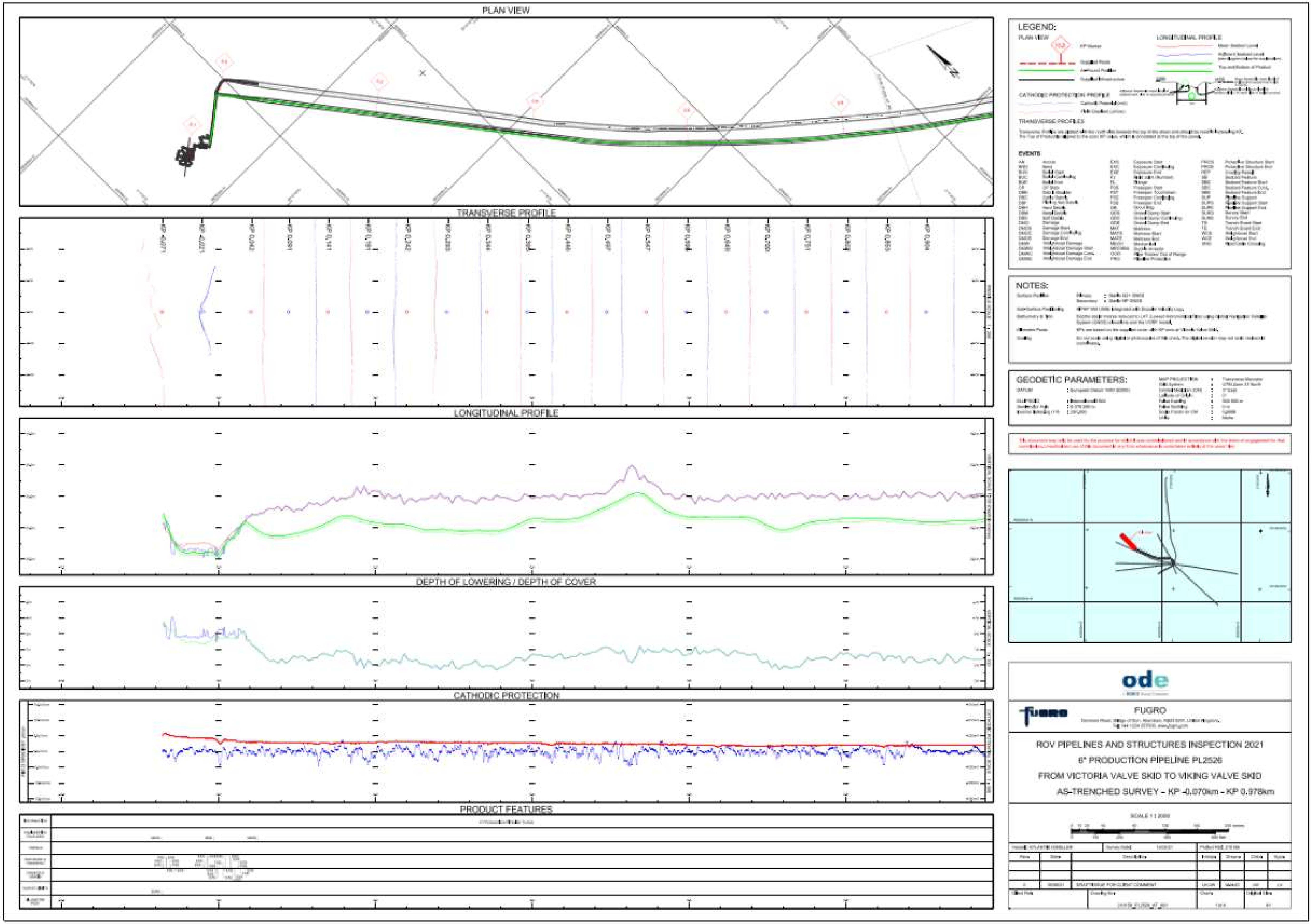
PROJECT: VICTORIA FIELD DEVELOPMENT

TITLE: UMBILICAL BURIAL STATUS VERSUS SAND WAVE MIGRATION PREDICTIONS

SIZE	SCALE	DRAWING No.	REV
A1	N.T.S		0.1

B.6 2021 Fugro Survey Charts

1. Chart 1 of 4: 2021 Pipeline Survey Chart (KP -070 – KP 0.978)
2. Chart 2 of 4: 2021 Pipeline Survey Chart (KP 0.908 – KP 2.100)
3. Chart 3 of 4: 2021 Pipeline Survey Chart (KP 2.049 – KP 3.241)
4. Chart 4 of 4: 2021 Pipeline Survey Chart (KP 3.116 – KP 3.820)
5. Chart 1 of 1: 2021 Umbilical Survey Chart (KP 0.000 – KP 0.992)
6. Chart 2 of 2: 2021 Umbilical Survey Chart (KP 0.911 – KP 2.103)
7. Chart 3 of 3: 2021 Umbilical Survey Chart (KP 2.057 – KP 3.249)
8. Chart 4 of 4: 2021 Umbilical Survey Chart (KP 3.215 – KP 3.930)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TRANSVERSE PROFILE
LONGITUDINAL PROFILE
DEPTH OF LOWERING / DEPTH OF COVER
CATHODIC PROTECTION
PRODUCT FEATURES
LEGEND:
PLAN VIEW
LONGITUDINAL PROFILE
CATHODIC PROTECTION PROFILE
TRANSVERSE PROFILES
EVENTS
NOTES:
GEODETIC PARAMETERS:
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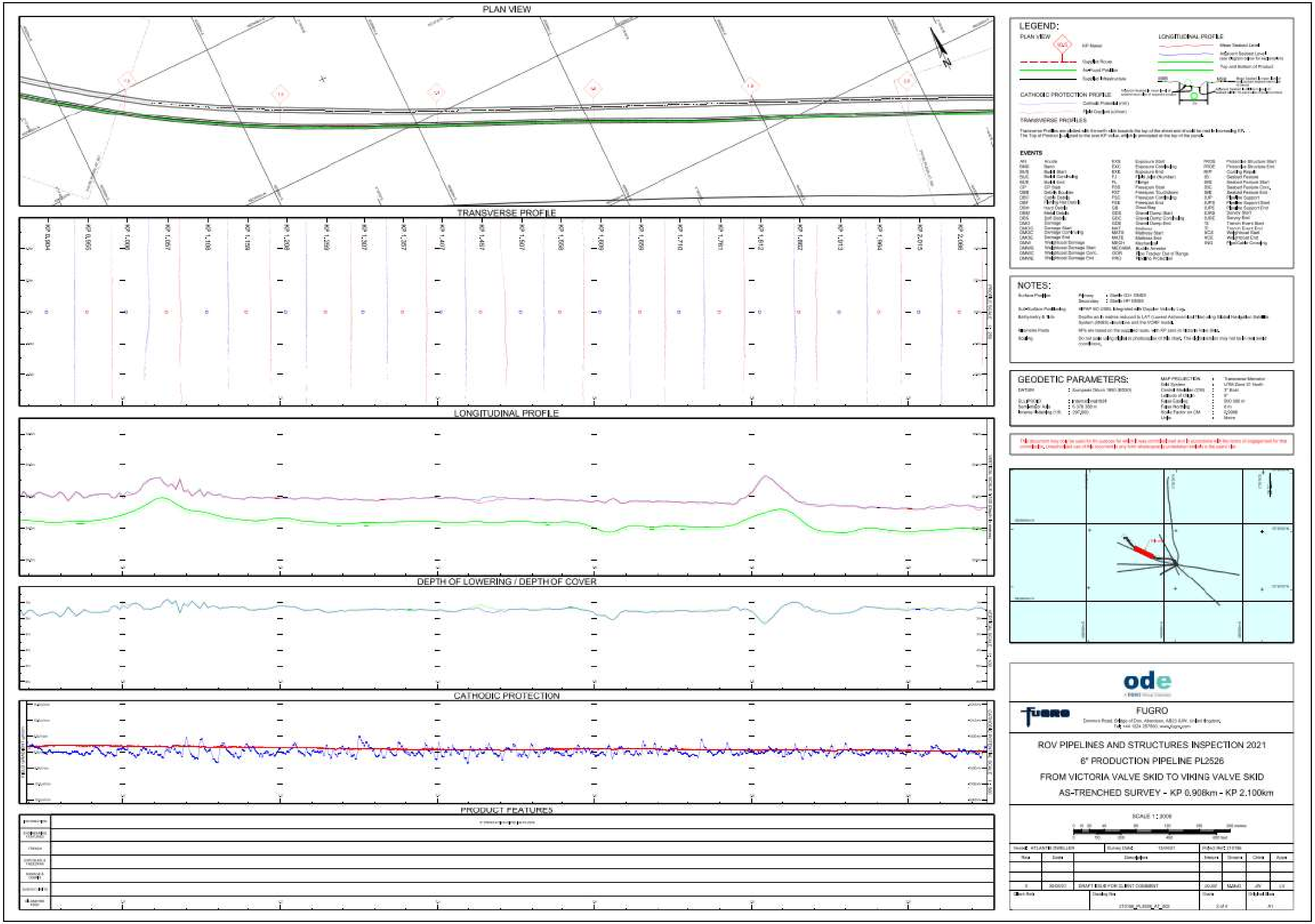
FUGRO
ROV PIPELINES AND STRUCTURES INSPECTION 2021
6" PRODUCTION PIPELINE PL2526
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
AS-TRENCHED SURVEY – KP -0.070km – KP 0.978km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LONGITUDINAL PROFILE
DEPTH OF LOWERING / DEPTH OF COVER
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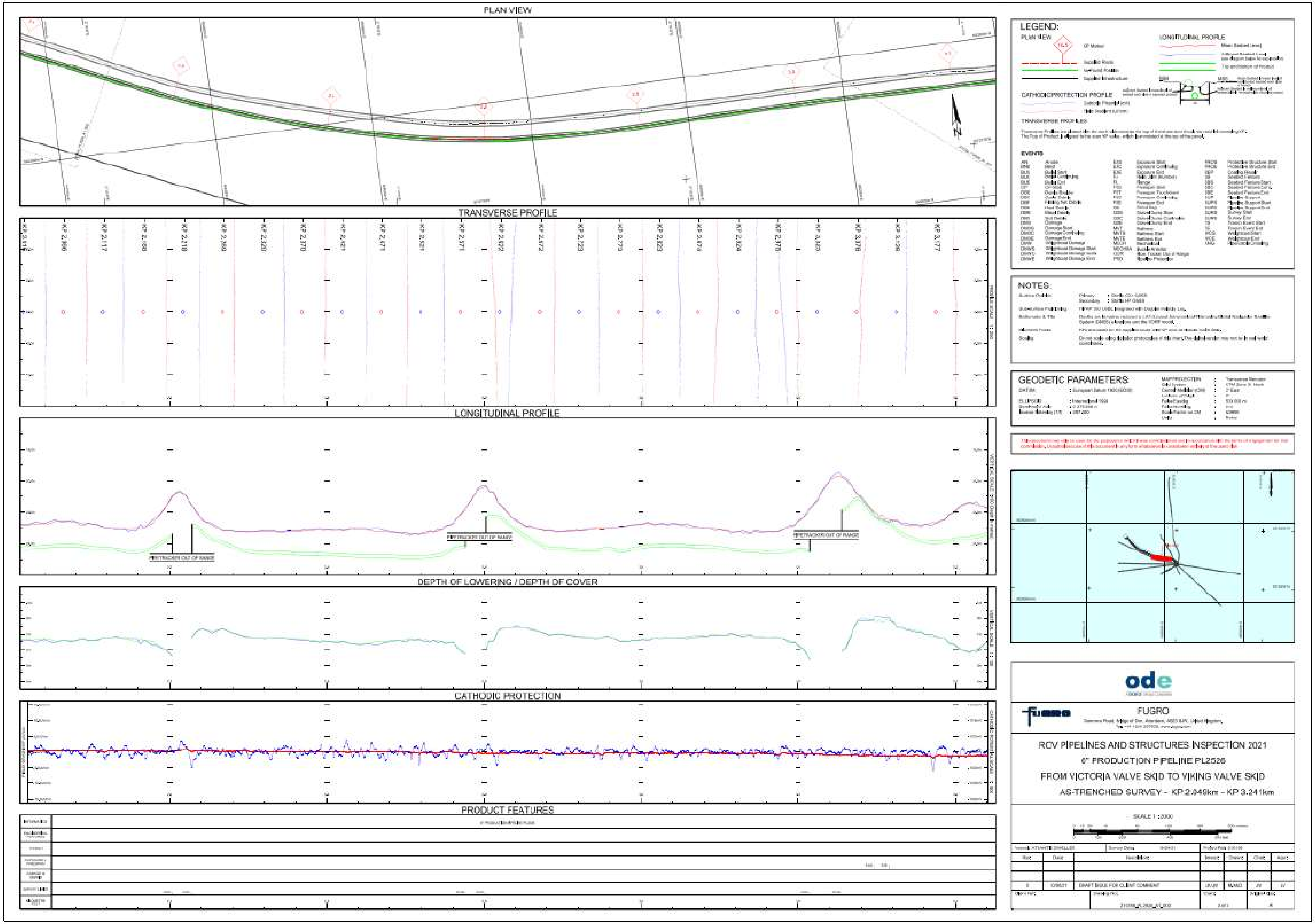
PRODUCT FEATURES
LEGEND:
NOTES:
GEODETIC PARAMETERS:
FUGRO
ROV PIPELINES AND STRUCTURES INSPECTION 2021
6" PRODUCTION PIPELINE PL2526
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
AS-TRENCHED SURVEY - KP 0.908km - KP 2.100km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TRANSVERSE PROFILE
LONGITUDINAL PROFILE
PIPETRACKER OUT OF RANGE
DEPTH OF LOWERING / DEPTH OF COVER
CATHODIC PROTECTION
PRODUCT FEATURES
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TRANSVERSE PROFILES
EVENTS
NOTES:
GEODETIC PARAMETERS
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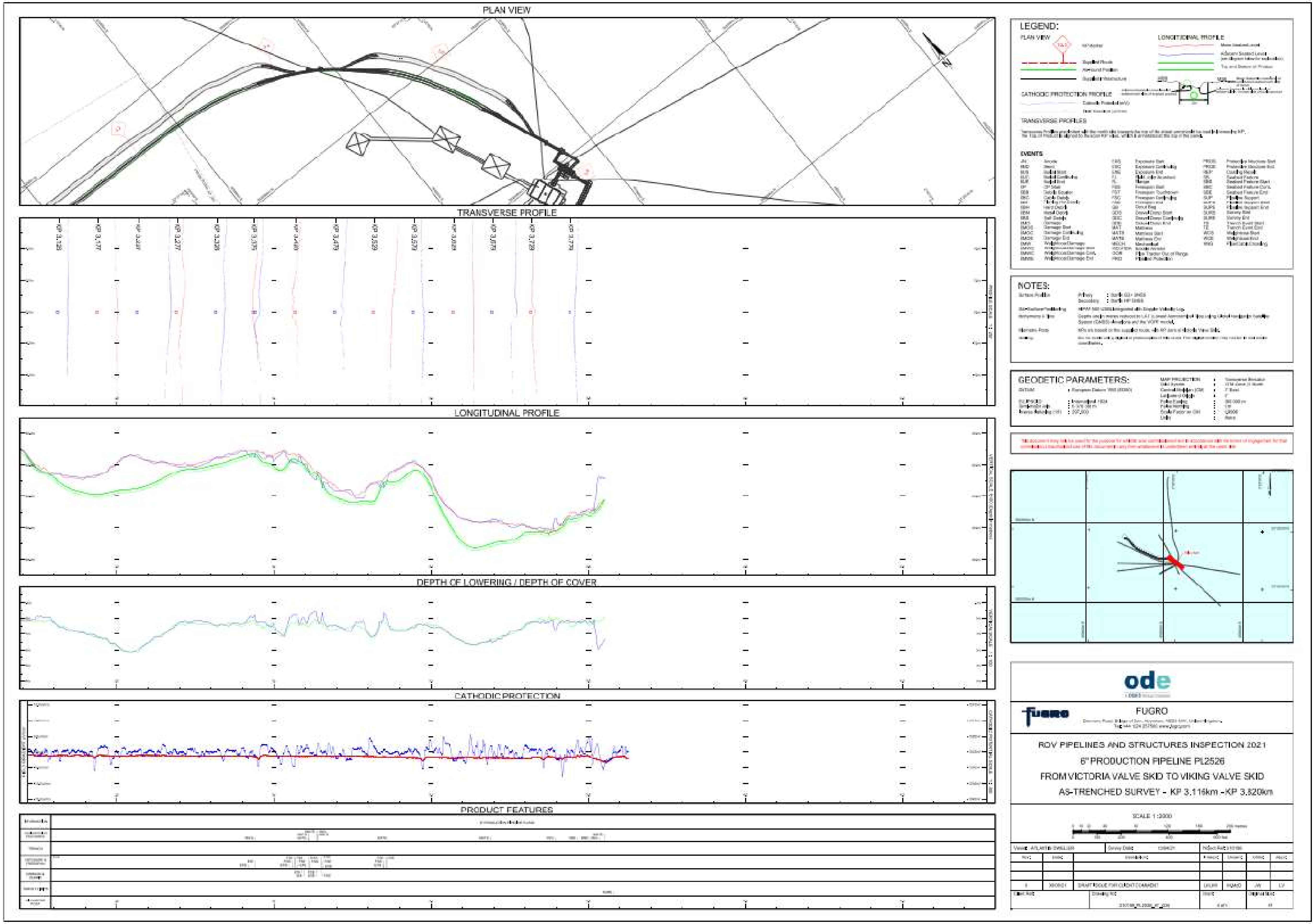
ROV PIPELINES AND STRUCTURES INSPECTION 2021
6" PRODUCTION PIPELINE PL2526
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
AS-TRENCHED SURVEY - KP 2.049km - KP 3.241km
SCALE 1 : 2000
DRAFT ISSUE FOR CLIENT COMMENT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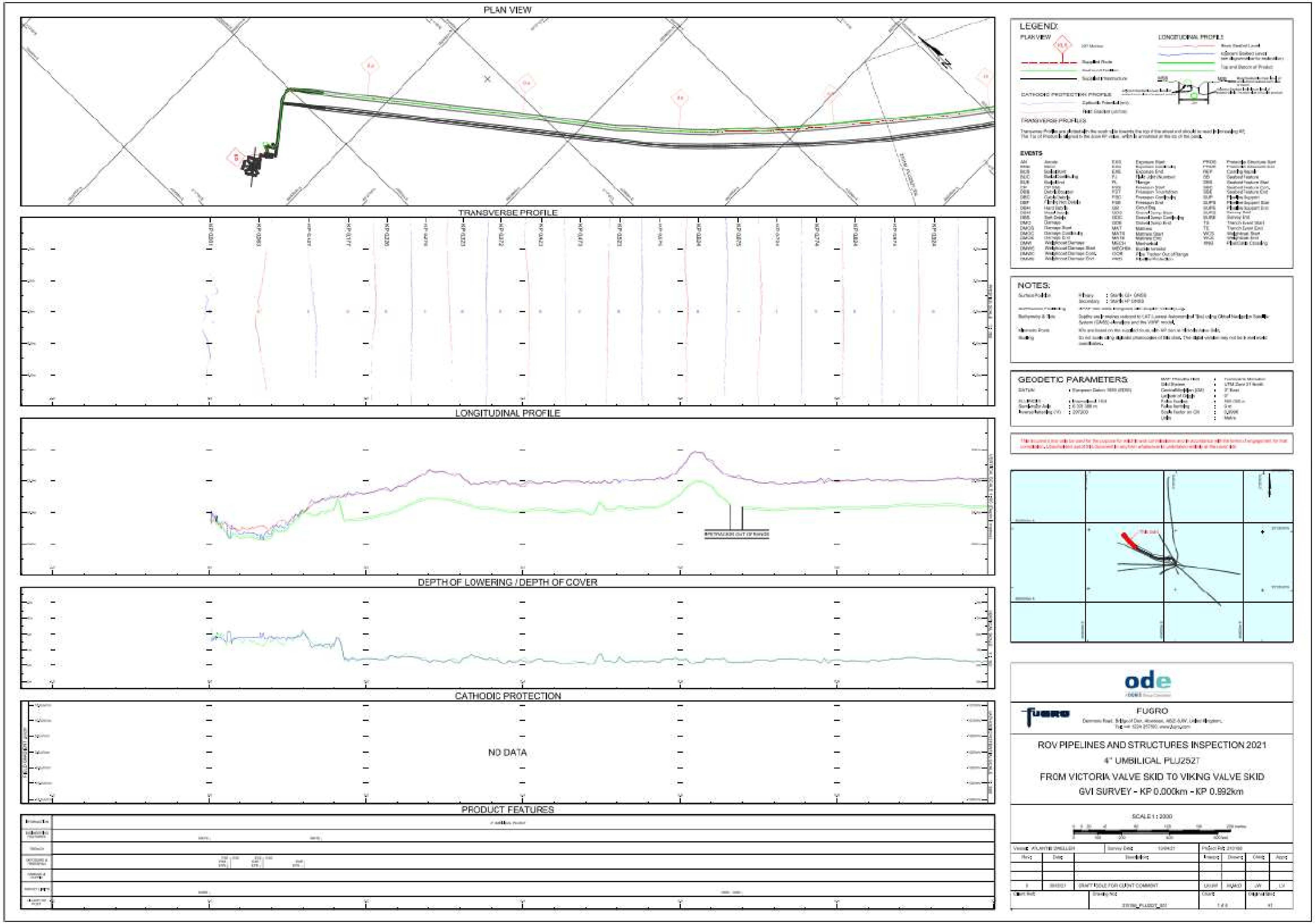
KP 3.126
KP 3.177
KP 3.227
KP 3.277
KP 3.328
KP 3.378
KP 3.428
KP 3.478
KP 3.529
KP 3.579
KP 3.629
KP 3.679
KP 3.729
KP 3.779
LONGITUDINAL PROFILE
DEPTH OF LOWERING / DEPTH OF COVER
CATHODIC PROTECTION
PRODUCT FEATURES
LEGEND:
PLAN VIEW
LONGITUDINAL PROFILE
CATHODIC PROTECTION PROFILE
TRANSVERSE PROFILES
EVENTS
NOTES:
GEODETIC PARAMETERS:
FUGRO
ROV PIPELINES AND STRUCTURES INSPECTION 2021
6" PRODUCTION PIPELINE PL2526
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
AS-TRENCHED SURVEY - KP 3.116km - KP 3.820km
SCALE 1:2000
DRAFT ISSUE FOR CLIENT COMMENT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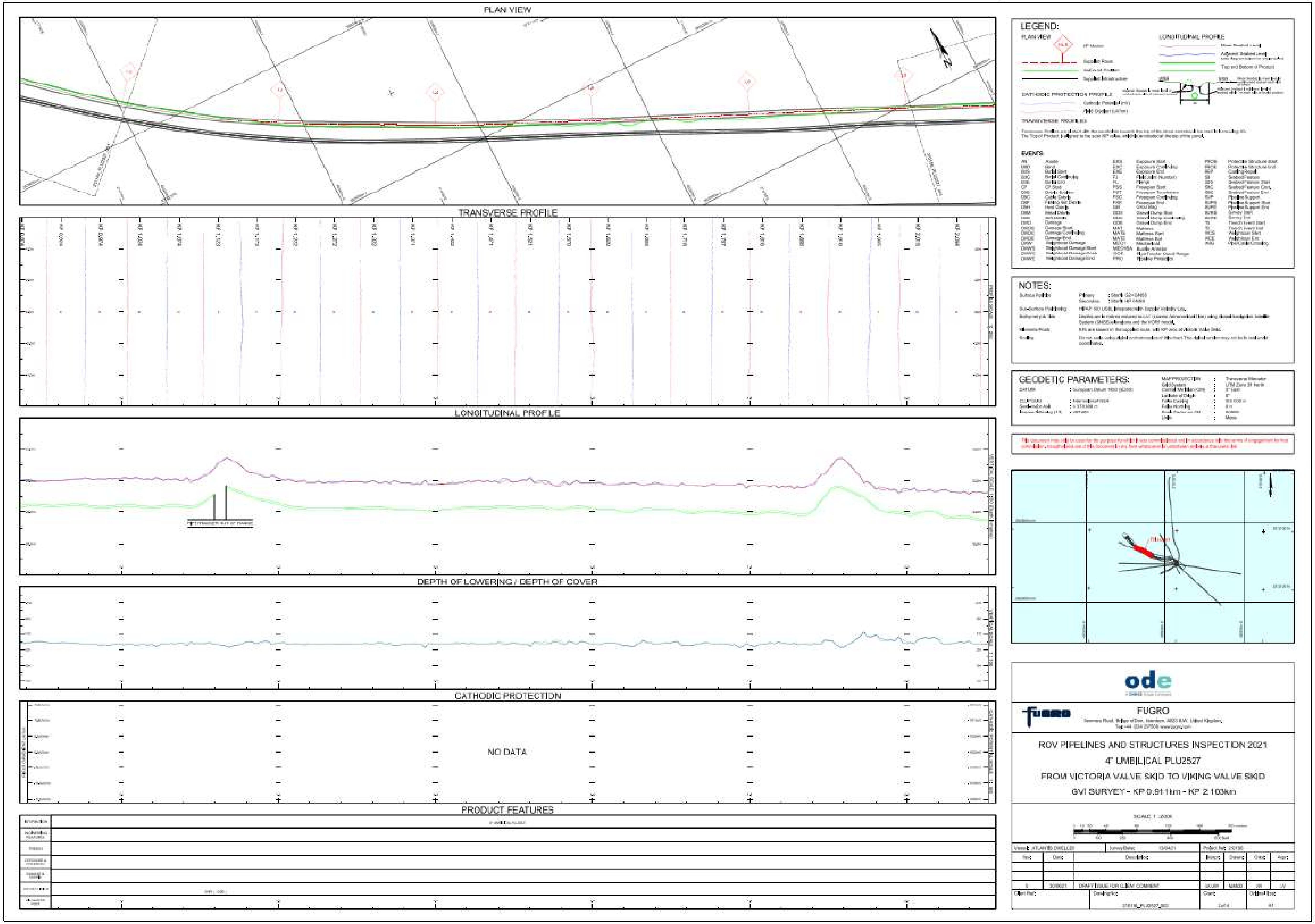
CATHODIC PROTECTION PROFILE
TRANSVERSE PROFILES
EVENTS
NOTES:
GEODETIC PARAMETERS
FUGRO
ROV PIPELINES AND STRUCTURES INSPECTION 2021
4" UMBILICAL PLU2527
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
GVI SURVEY - KP 0.000km - KP 0.992km
SCALE 1 : 2000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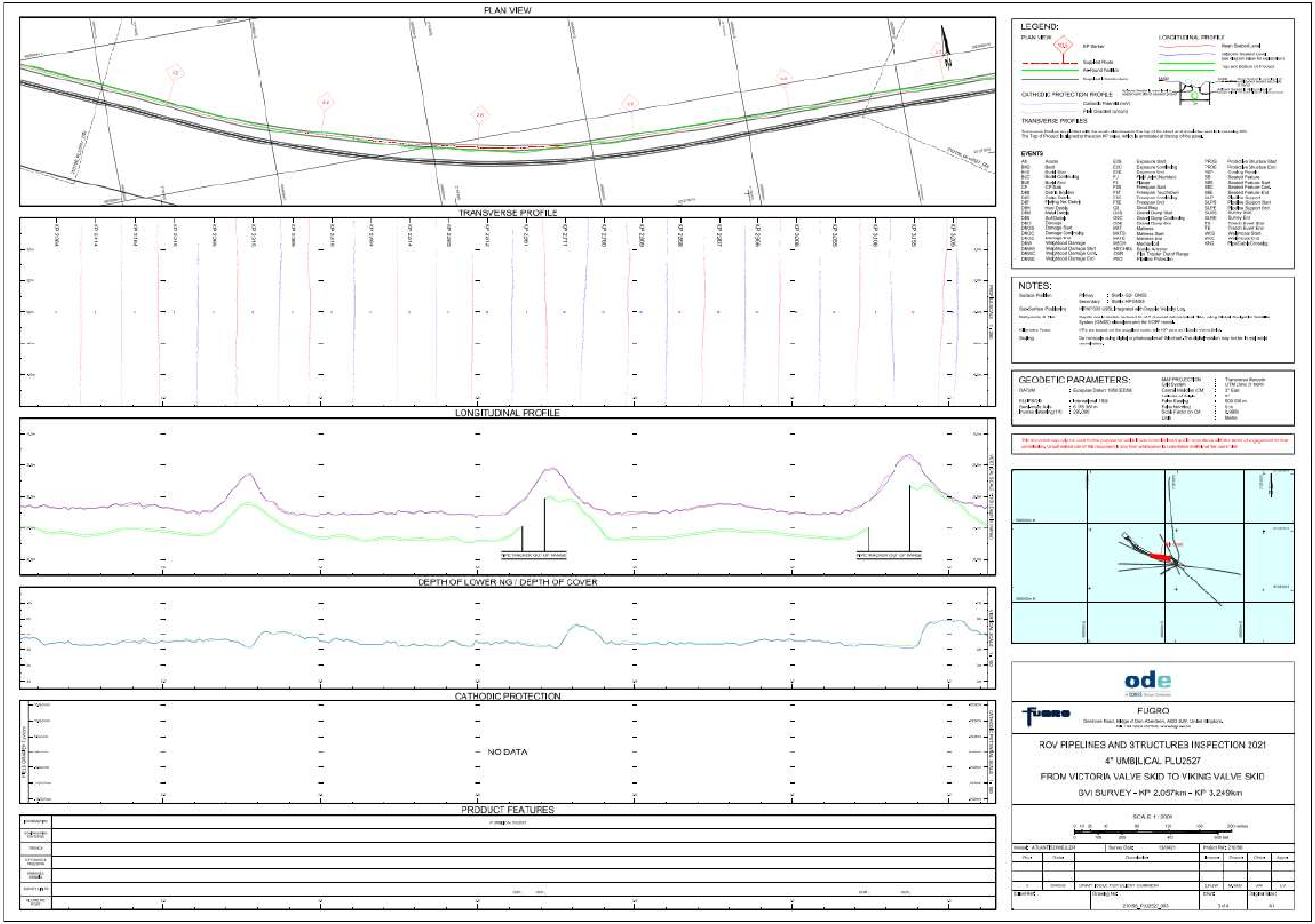
ROV PIPELINES AND STRUCTURES INSPECTION 2021
4" UMBILICAL PLU2527
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
GVI SURVEY - KP 0.911km - KP 2.103km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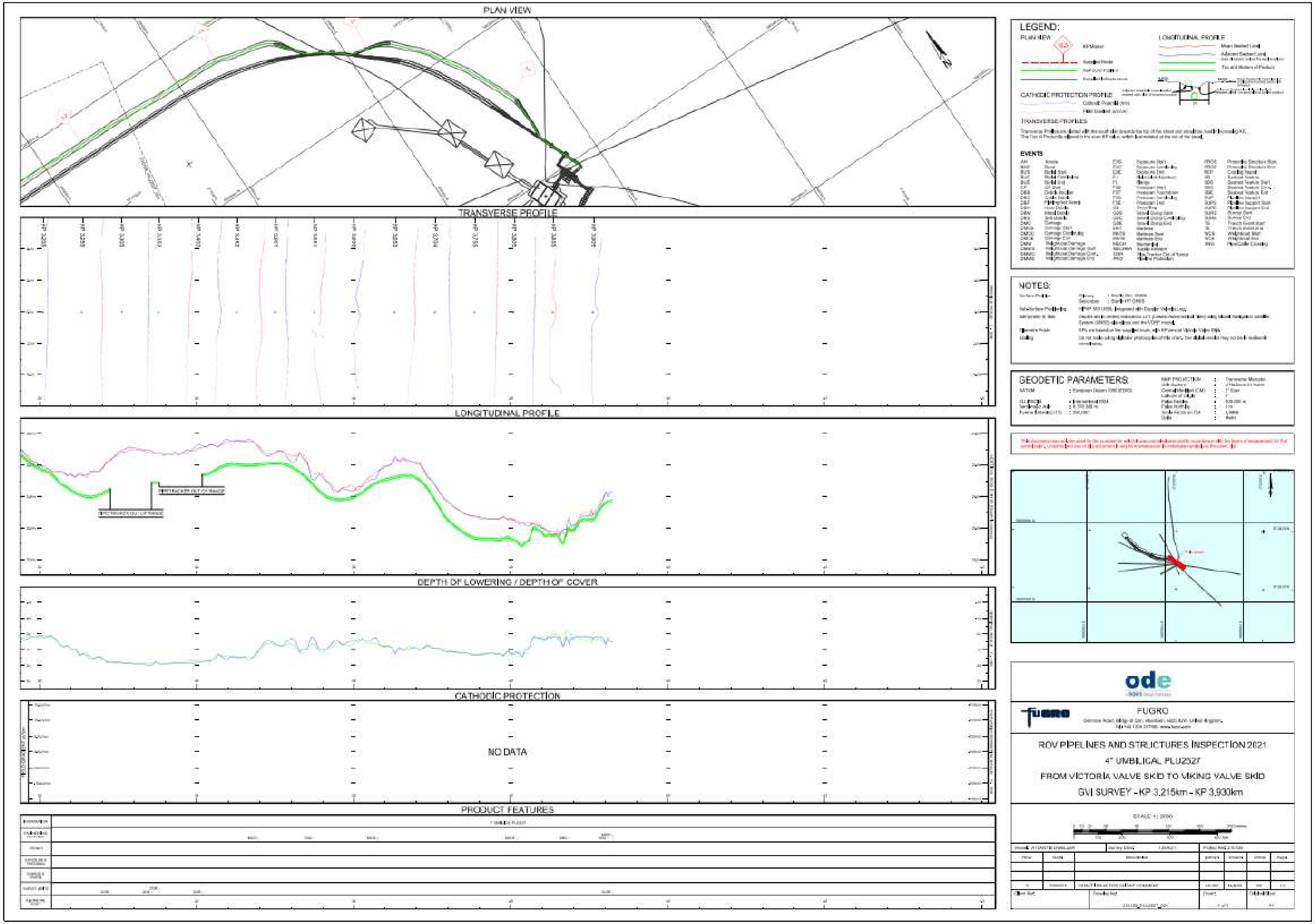
TRANSVERSE PROFILES
EVENTS
NOTES:
GEODETIC PARAMETERS:
FUGRO
ROV PIPELINES AND STRUCTURES INSPECTION 2021
4" UMBILICAL PLU2527
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
GVI SURVEY - KP 2.057km - KP 3.249km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LONGITUDINAL PROFILE
CATHODIC PROTECTION PROFILE
TRANSVERSE PROFILES
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NOTES:
GEODETIC PARAMETERS
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FUGRO
ROV PIPELINES AND STRUCTURES INSPECTION 2021
4" UMBILICAL PLU2527
FROM VICTORIA VALVE SKID TO VIKING VALVE SKID
GVI SURVEY - KP 3.215km - KP 3.930km

Appendix C 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 under a DSV. A CSV may be used in place of a DSV, however, the energy consumption associated with a working DSV is anticipated to be higher.
- 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 C 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 C 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 C 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 C 4 Energy consumption factors used in the calculations for vessel fuel consumption

Vessel	Total Duration (days)*	Fuel consumption (tonnes/day)				Source/ comments
		Mob/ demob	In transit	Working	Waiting on weather	
DSV	50	8	30	15	18	Provided by NEO
Guard vessel	18	0.2	0.8	0.7	0.7	IoP (2000) factors for standby vessel
Rock placement vessel	6	2	8	15	15	IoP (2000) factors
Survey vessel	9	3	22	18	10	IoP (2000) factors for Remotely Operated Vehicle Support Vessel (ROVSV)
Jack-up rig (cumulative)	25	5	25	20	15	Provided by NEO

*Worst case and includes mob/ demob, transit and working days