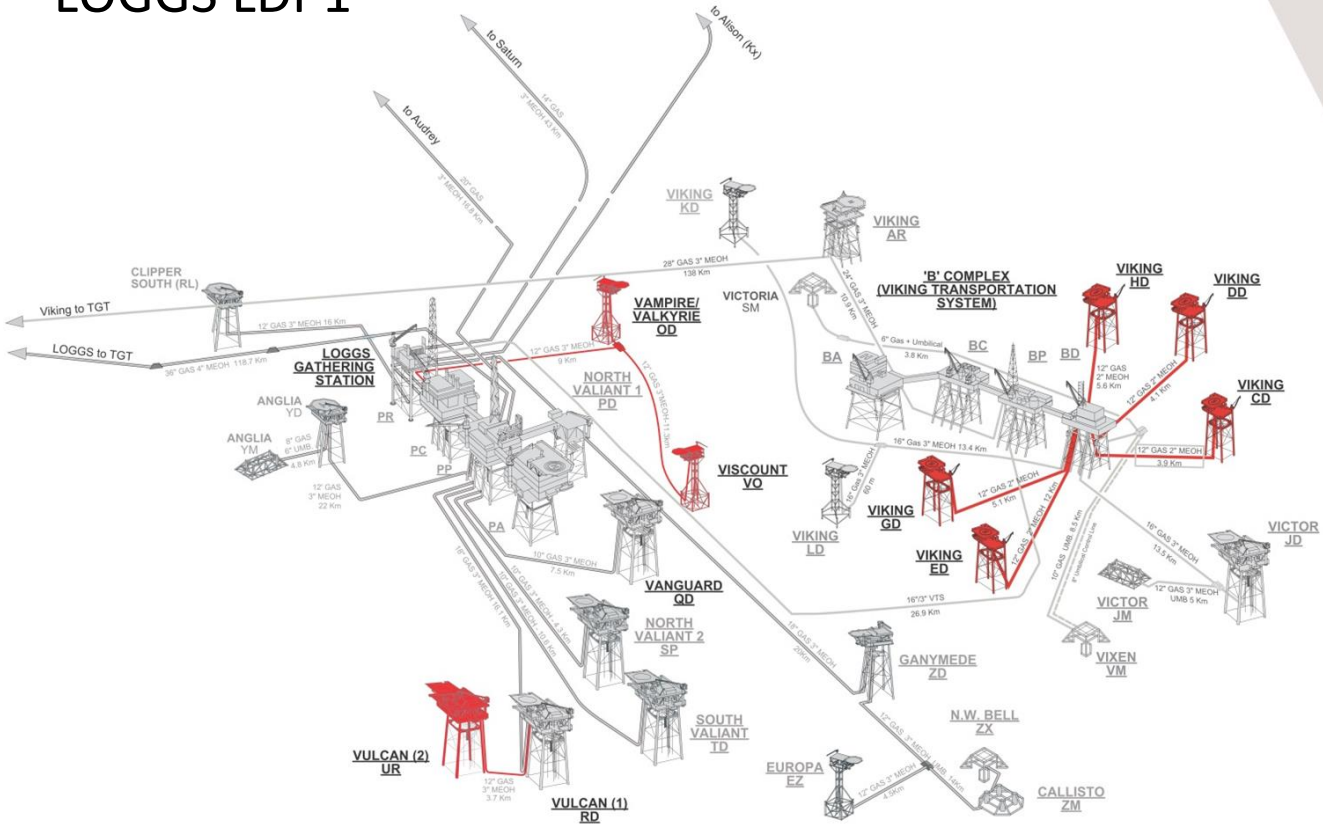
ConocoPhillips

SNS PHASE 1 DECOMMISSIONING PROJECT

ENVIRONMENTAL STATEMENT FOR THE SNS DECOMMISSIONING PROJECT: VIKING VDP1 AND LOGGS LDP1



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Information Sheet

Project Name:	Environmental Statement for the SNS Phase 1 Decommissioning Project: Viking VDP1 and LOGGS LDP1
Type of Project:	Decommissioning
Undertaker Name:	ConocoPhillips (U.K.) Limited
Address:	Rubislaw House Anderson Drive Aberdeen AB15 6FZ
Short Description:	ConocoPhillips (U.K.) Limited plans to decommission a number of assets in the southern North Sea (SNS). This Environmental statement details the findings of the Environmental Impact Assessment (EIA) conducted by ConocoPhillips (U.K.) Limited in support of its two decommissioning Programmes, Viking Decommissioning Programme 1 (VDP1) and Lincolnshire Offshore Gas Gathering Systems (LOGGS) Decommissioning Programme 1 (LDP1) which form part of its phased decommissioning of its SNS assets. This EIA will support two decommissioning programmes (DPs). The infrastructure to be decommissioned and included as part of VDP1 and LDP1 is located in the United Kingdom continental shelf (UKCS) Blocks 48/25, 49/16, 49/17 and 49/21 and comprises 16 pipelines, eight satellite platforms and associated subsea structures and protection.
Anticipated commencement of works:	Q4 2015
Other documents relative to this project	This ES supports two Decommissioning Programmes: VDP1: COP-SNS-V-XX-X-PM-12-00001 LDP1: COP-SNS-L-XX-X-PM-12-00001
Significant Environmental Impacts Identified:	None
Statement Prepared By:	ConocoPhillips (U.K.) Limited and BMT Cordah Limited

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ABBREVIATIONS, ACRONYMS AND UNITS

Definition	
$\mu g g^{-1}$	micrograms per gram
µPa	micropascal
3PLE	3 Layer Polyethylene
AIS	Automated Identification System
ALARP	As low as reasonably possible
ANIFPO	Anglo-North Irish Fish Producers' Organisation
As	Arsenic
AWV	Accommodation Work Vessel
Ba	Barium
BATs	Best Available Techniques
BC	Background Concentration
BEP	Best Environmental Practice
BOD	Biological Oxygen Demand
BTA	Buoyancy Tank Assemblies
BWM	Ballast Water Management
°C	Degrees Celsius
C	Carbon
CA	Comparative Assessment
Cd	Cadmium
CH_4	Methane
CHARM	Chemical Hazard Assessment and Risk Management
cm	centimetre(s)
CMS	Caister Murdoch System
CO_2	Carbon Dioxide
Cr	Chromium
CSV	Construction Support Vessel
CtL	Consent to Locate
Cu	Copper
dB	decibel
$dB_{ht\ (species)}$	Sound level in decibels above the hearing threshold of a species
DECC	Department of Energy and Climate Change
DP	Dynamic Positioning
DPs	Decommissioning Programmes
DSV	Dive Support Vessel
E&P	Exploration and Production
EA	Environment Agency
EA 2008	Energy Act 2008
EAC	Environmental Assessment Criteria
EBS	Environmental Baseline Survey
EC	European Commission
EDC	Engineering Down and Cleaning
EIA	Environmental Impact Assessment
ELD	Environmental Liability Directive

EMAS	Eco-Management and Audit Scheme
EMOBF/ LTOBF	Enhanced Mineral Oil-Based Fluids/Low Toxicity Oil-Based Fluids
EMS	Environmental Management System
EPS	European Protected Species
ERL	Effects Range - Low
ES	Environmental Statement
EUNIS	European Nature Information System
FBE	Fusion Bonded Epoxy
FC&D	Final Cleaning and Disconnect
Fe	Iron
FEPA	Food and Environment Protection Act
F-gas	Fluorinated Greenhouse Gases
FLO	Fisheries Liaison Officer
FSU	Floating Storage Unit
GHGs	Greenhouse Gases
GJ	Gigajoules
GMS	Global Marine Systems Ltd
GRT	Gross Register Tonnage
HASS	High Activity Sealed Source
HAZID	Hazard Identification study
HAZOP	Hazard and Operability
Hg	Mercury
HLV	Heavy Lift Vessel
HSE	Health and Safety Executive
Hz	hertz
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
IoP	Institute of Petroleum
IOPP	International Oil Pollution Prevention
IPPC	Integrated Pollution Prevention and Control
JNCC	Joint Nature Conservation Committee
kg	kilogram(s)
kHz	kilohertz
km	kilometre(s)
LAT	Lowest Astronomical Tide
LDP1	LOGGS Decommissioning Programme 1
LOGGS	Lincolnshire Offshore Gas Gathering Systems
LSE	Levels of Significant Exposure
m	metre(s)
m/s	metres per second
MARPOL (convention)	International Convention for the Protection of Pollution from Ships
MCA	Maritime and Coastguard Agency
MCAA	Marine and Coastal Access Act
MCZs	Marine Conservation Zones
MeOH	Methanol
MMO	Marine Management Organisation

Mn	Manganese
MoD	Ministry of Defence
MSA	Marine Scotland Act
MSFD	Marine Strategy Framework Directive
MSV	Multi-support Vessel
MW	megawatt(s)
Nb	Niobium
ND	No Data
NE	Natural England
NER	New Entrants Reserve
NFFO	National Federation of Fishermen's Organisation
ngg^{-1}	nanograms per gram
Ni	Nickel
NIEA	Northern Ireland Environment Agency
NIFPO	Northern Irish Fish Producers' Organisation
NORM	Naturally Occurring Radioactive Material
NOx	Oxides of Nitrogen
OBF	Oil Based Fluids
OCNS	Offshore Chemical Notification Scheme
OPEPs	Oil Pollution Emergency Plans
OPF	Organic Phase Fluids
OPOL	Oil Pollution Operator's Liability
OPPC	Oil Pollution Prevention and Control
OPRC	Oil Pollution Preparedness, Response and Co-operation Convention
OSCAR	Oil Spill Contingency and Response
OSIS	Oil Spill Information System
OSPAR	Oslo and Paris Conventions
P	Phosphorus
P&A	Plug and Abandonment
PA	Petroleum Act
PAH	Polycyclic Aromatic Hydrocarbon
Pb	Lead
PETS	Portal Environmental Tracking System
PFP	Passive Fire Protection
PLONOR	Pose Little or No Risk
POPA	Prevention of Oil Pollution Act
ppt	parts per trillion
PSV	Platform Supply Vessel
PTS	Permanent Threshold Shift
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RL	Received Level
rms	route mean squared
ROV	Remotely Operated Vehicle
ROVSV	ROV Support Vessel
S	Sulphur
SAC	Special Area of Conservation
SBF	Synthetic Based Fluids

SCANS	Small Cetaceans in the European Atlantic and North Sea
SCI	Site of Community Importance
SEL	Sound Exposure Level
SEPA	Scottish Environment Protection Agency
SFF	Scottish Fisherman's Federation
SL	Source Level
SLV	Single Lift Vessel
SNS	Southern North Sea
SO_2	Sulphur Dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSREP	Secretary of State for Energy and Climate Change
SOx	Oxides of Sulphur
SPA	Special Protection Area
SPL	Sound Pressure Level
TBT	Tributyltin
TGT	Theddlethorpe Gas Terminal
THC	Total Hydrocarbon Concentration
Ti	Titanium
TTS	Temporary Threshold Shift
UCM	Unresolved Complex Mixture
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKHO	United Kingdom Hydrographic Office
UKOPP	UK Oil Pollution Prevention Certificate
UNCLOS	United Nations Convention on the Law of the Sea
V	Vanadium
VDP1	Viking Decommissioning Programme 1
VisNed	VisNed is the voice of the Dutch cutter fleet, Fish Producer Organisations from Urk, Southwest and North Netherlands.
VMS	Vessel Monitoring System
VOC	Volatile Organic Compounds
VTS	Viking Transportation System
WFD	Waste Framework Directive
WOW	Wait on Weather
Zn	Zinc

GLOSSARY

A Complex	A term referring to the old 'A' field platforms that have been previously decommissioned in the Viking A Field.
Acid rain	Precipitation of acidic pollutants, chiefly sulphur dioxide and nitrogen oxide, released into the atmosphere by the burning of fossil fuels such as oil.
Amphipod	Any of numerous small, flat-bodied crustaceans of the group Amphipoda, including the beach fleas, sand hoppers, etc.
Annex I	Legislation protecting certain habitats.
Annex II	Legislation protecting certain organisms.
Anthropogenic	Relating to human activities (or man-made).
Bathymetry	The measurement of water depth in oceans, sea and lakes.
Benthic Fauna	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 10km x 20km forming part of a quadrant, e.g. Block 21/05 is the 5th block of Quadrant 21.
Chlorofluorocarbons	Non-toxic, non-flammable chemicals containing atoms of carbons, chlorine and fluorine. A major contributor to ozone depletion.
Chromatogram	The column, gel layer, or paper strip on which some or all of the constituents of a mixture have been separated by being adsorbed at different locations.
Coal tar	A viscous black liquid containing numerous organic compounds that is obtained by the destructive distillation of coal. Used for coating pipelines, once cool coal tar sets as a hard impregnable coating.
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.
Controlled Waste	The term Controlled Waste is defined in Section 75(4) of the Environmental Protection Act 1990 as: "household, industrial and commercial waste or any such waste." Not all radioactive waste is classified as controlled waste and may be regulated under The Radioactive Substances Act 1993 (explained below).
Copepods	Small planktonic crustaceans that form a vital part of many marine food webs.
Crude oil	Unprocessed naturally occurring oil.
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.
Decommissioning	Shutdown of the development with system cleaning and dismantling of facilities.
Decommissioned *in situ*	Left in its current location
Demersal	The zone that is the part of the sea or ocean (or deep lake) comprising the water column that is near to (and is significantly affected by) the seabed.

Directive Waste	Directive Waste is defined in Article 1(a) of Council Directive 75/442/EEC as: “any substance or object which the producer or the person in possession of it discards or intends or is required to discard”. In determining if a substance or object has been discarded, the following question may be asked: “has the substance or object been discarded so that it is no longer part of the normal commercial cycle or chain of utility?”
Dispersant	An agent added to a suspension to improve the separation of particles. Dispersants added to spilled oil can help the oil break up into smaller droplets, increasing the exposed surface area and the rate of degradation.
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.
Dual Van Veen Grab	An instrument to sample sediment in the ocean.
Dynamic Positioning	A system of sensors and thrusters on a vessel which allows it to maintain position using satellite telemetry to adjust thrusters’ direction and power.
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.
Ecotoxicological	See ‘Ecotoxicology‘
Ecotoxicology	Ecotoxicology is the study of the effects of toxic chemicals on biological organisms, especially at the population, community, ecosystem level
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.
Environmental Statement	A report setting out the findings of an assessment of a project’s environmental impacts.
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.
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.
Epibenthic	Organisms that live on the surface of sediments at the bottom of the sea.
Epifauna	Fauna inhabiting the surface of rocks, sediment or other fauna/flora.
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.
Fauna	Animal life.
Flora	Plant life.
Frond mats	Mattress with buoyant fronds attached installed to reduce scour.
Gas chromatographic profiles	Profiles derived from using gas chromatography. This method is used to analyze mixtures of volatile organic compounds by using an inert gas to carry the mixture through a column resulting in a peaked graph – each peak indicating the presence of a particular compound.
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	A group in the periodic table consisting of five chemically related elements: fluorine (F), chlorine (Cl), bromine (Br), iodine (I), and astatine (At).
Halophilous scrubs	Shrub formations that thrive in an environment with high salt concentrations
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	A life stage for most animals of the class Hydrozoa (individually very small, predatory animals, some solitary and some colonial, most living in salt water). May grow on man-made substrate.
Infauna	Fauna that lives within sediments.
Inorganic	Not having the structure or characteristics of living matter (not considered organic).
Macrofauna	Benthic or soil organisms which are larger than 0.5mm.
Marine Scotland	A government consultee and a lead marine management organisation in Scotland, bringing together the functions of Marine Scotland Science, Marine Scotland Compliance and the Scottish Government Marine Directorate.
Mattresses	A structure to support, protect and provide stability to pipelines and to give any additional dropped object protection.
Megaripples	Large, sand waves or ripple-like features having wavelengths greater than 1 meter or a ripple height greater than 10 centimeters
Mesocosm	An experimental tool that brings ecologically relevant components of the natural environment under controlled conditions.
Multi-beam echosounder	A multi-beam echosounder used to measure and record seabed bathymetry over a wide strip or area beneath the survey vessel.
Non-Hazardous Waste	Material that does not fall within the classification of Special or Hazardous Waste.
Notification to mariners	Admiralty Notice to Mariners containing all the corrections, alterations and amendments for the UK Hydrographic Office (UKHO) worldwide series of Admiralty Charts and Publications, published weekly as booklets, which are despatched directly from the UKHO.
Organic	Compounds containing carbon and hydrogen.
Organotin	An organic compound with one or more tin atoms in its molecules.
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.
Photochemical pollution	Air pollution caused by the reaction of unsaturated and saturated hydrocarbons, aromatics and aldehydes (emitted owing to the incomplete combustion of fuels) with light.
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.
Polychaete	A class of marine annelid worms.
Protozoans	Protozoa are single celled organisms. They come in different shapes and sizes and live in a wide variety of moist habitats including freshwater, seawater and soil.
Radioactive Waste	The Environmental Permitting Regulations 2010 superseded The Radioactive Substances Act 1993 in England and Wales. These Regulations define radioactive waste as: “waste which falls within one or more of the following three categories and fails to meet any of the exemption criteria defined in the Regulations; i) It arises from defined industrial activities, and the concentrations of radionuclides in the waste are greater than the values set in the Regulations. ii) It contains naturally occurring radionuclides, from a defined list, that are used for their radioactive, fertile or fissile properties, and, for solids and relevant liquids, the concentration of the nuclides in the waste exceeds the values defined in the Regulations. iii) It contains artificial radionuclides, and, for solids and relevant liquids, the concentration of radionuclides in the waste exceeds the values defined in the Regulations”. For the purposes of the decommissioning activities the main source of

	Radioactive waste as defined by the Environmental Permitting Regulation 2010 falls under Naturally Occurring Radioactive Material (NORM) from Industrial Activities as described in the Regulations - “Removal and management of radioactive scales and precipitates from equipment associated with industrial activities”.
Risk	The combination of the probability of an event and a measure of the consequence.
Rock-placement	Deposition of rock onto subsea pipelines, to provide protection against anchors and trawlnets, when burying completely the pipe is impossible.
Salinity	The dissolved salt content of a body of water.
Scour pit	The result of the process by which tides and currents carry away loose sediment from around a fixed object on the seabed such as a platform leg or pipeline or rock.
Shoal	A sandy elevation of the bottom of a body of water, constituting a hazard to navigation; a sandbank or sandbar.
Shut-in	A term used to describe the isolation of the wellbore by means of closing the master valve.
Side-scan sonar	Acoustic survey equipment towed close to the seabed, typically used for surveying pipelines.
Stochastic model or simulation	A model/simulation involving or containing a random variable or variables; involving chance or probability.
Stratification	Separation of a body of water into two or more distinct layers due to differences in density or temperature.
Sublittoral	The area between the low water line and the edge of the continental shelf.
Substrate	In this context, any surface which could provide a habitat for an organism to live, i.e. a rock outcropping or area of sand.
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.
Tie-Back	Tie-backs connect new oil and gas discoveries to existing production facilities.
UKCS	Areas of the United Kingdom Continental Shelf waters in which the UK Government has jurisdiction over oil and gas activity.
Wait on Weather (WoW)	When a rig or vessel is “waiting on weather”, this refers to a period of time when no work can be undertaken due to risk to equipment and personnel safety.
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.
Xmas tree	A structure fixed to the seabed which comprises a system of valves to control flow from a well into production flowlines.
Zooplankton	Broadly defined as heterotrophic (deriving energy from organic matter) planktonic organisms, although some protozoan zooplankton species can derive some energy from sunlight.

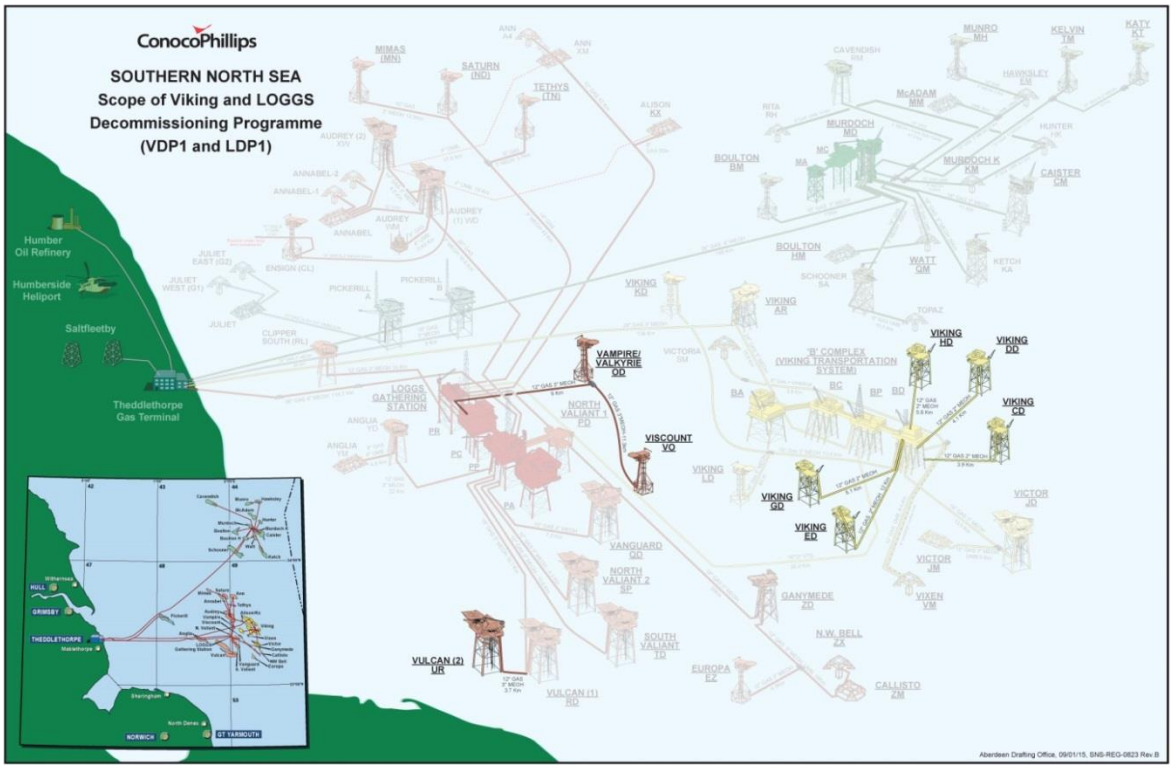
NON-TECHNICAL SUMMARY

This non-technical summary outlines the findings of the Environmental Impact Assessment (EIA) conducted by ConocoPhillips (U.K.) Limited (ConocoPhillips) in support of the two decommissioning Programmes, Viking Decommissioning Programme 1 (VDP1) and Lincolnshire Offshore Gas Gathering Systems (LOGGS) Decommissioning Programme 1 (LDP1).

The purpose of the EIA is to understand and communicate the significant environmental impacts associated with the decommissioning options proposed under VDP1 and LDP1 and to inform the decision-making process. The detailed assessment is presented within the Environmental Statement.

The VDP1 and LDP1 infrastructure are located in the United Kingdom Continental Shelf Blocks 48/25, 49/16, 49/17 and 49/21 in the southern North Sea (Figure i). The Vulcan UR platform, which is the closest to shore is located approximately 55 km northeast of the Norfolk coast.

The VDP1 infrastructure is composed of five platforms (Viking CD, DD, ED, GD and HD) and ten pipelines (five gas pipelines and five piggybacked methanol lines). The LDP1 infrastructure is composed of three platforms (Vampire VO, Viscount OD and Vulcan UR) and six pipelines (three gas pipelines and three piggybacked methanol lines) and a T-piece pipe junction with supporting structure and mattress protection.



***** VDP1 infrastructure is in yellow and LDP1 infrastructure is in red.

Figure i: ConocoPhillips SNS infrastructure to be decommissioned under VDP1 and LDP1

Regulatory Context

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

At present there is no statutory requirement to prepare an Environmental Statement for decommissioning. However, under the *Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998* (DECC Guidance Notes) the Decommissioning Programme must be supported by an EIA.

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

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

In addition, DECC have advised the Oil and Gas Industry that under the Marine and Coastal Access Act 2009 (MCAA) and the Marine (Scotland) Act 2010 an EIA/ Environmental Statement will be required for all licence applications relating to decommissioning operations.

OSPAR Decision 98/3 (the Decision) sets out the United Kingdom'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 tonnes must be completely removed for re-use, recycling or disposal on land. Any piles securing the jacket to the seabed should be cut below the natural seabed level at a depth that will ensure they remain covered. The depth of cutting is dependent upon the prevailing seabed conditions and currents.

OSPAR Decision 98/3 does not include the decommissioning of pipelines. 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 DECC 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 Comparative Assessment made.

Scope the Viking and LOGGS Decommissioning Programmes, VDP1 and LDP1

The main elements of VDP1 and LDP1 include the following:

- Plug and abandonment of the wells in accordance with the well abandonment programme (covered in a separate environmental assessment).
- Preparation, final cleaning and removal of mobile hydrocarbons, production chemicals and mobile solids from pipelines and topsides (gas, methanol and corrosion inhibitor) and subsequent flooding of pipelines (decommissioned *in situ*) with seawater.
- Preparation of infrastructure for removal by specialist contractors to an approved onshore disposal facility.
- Leaving installations in cold suspension marked with appropriate navigational aids for up to two years.
- Removal of infrastructure by lifting vessel.
- Dismantling and disposal of infrastructure to be removed at an onshore reception facility.

The decommissioned structures will be taken to an appropriate onshore disposal yard located within Europe. Disposal yard selection remains to be made.

Decommissioning Studies

ConocoPhillips have conducted a number of studies in support of the VDP1 and LDP1 planning process and option evaluation, in order to determine the decommissioning options and optimal engineering solutions. The conclusions from these are included within the Environmental Statement, Table i, provides a list of these studies.

Table i: Supporting studies commissioned by ConocoPhillips.

Study/ Survey Title
Noise Assessment Report for the SNS Phase 1 Decommissioning Project
Comparative Assessment Report
Energy Use and Emissions Report
Marine Growth Assessment
Commercial Fisheries Socioeconomic Impact Study
Socioeconomic and Environmental Impact Assessment Scoping Report
Pipeline Materials Inventory and Degradation Technical Note
Infield Pipelines Cleaning Technical Note
Pipeline Burial Technical Note
Mattress Inventory and Removal Technical Note
Materials Inventory Report – Stage 1 and 2
ConocoPhillips (U.K.) Limited SNS decommissioning survey. UKCS 48 and 49. Viking AR, CD, DD, ED, GD, and HD. Habitat Assessment Report J/1/20/2342-3
ConocoPhillips (U.K.) Limited SNS decommissioning survey. UKCS 48 and 49. Viscount VO, Vulcan UR and Vampire/Valkyrie OD (LOGGS). Habitat Assessment Report J/1/20/2342-2
ConocoPhillips (U.K.) Limited SNS decommissioning survey. UKCS 48 and 49. Viking AR, Viking CD and Viking GD. Decommissioning Environmental Report J/1/20/2342
ConocoPhillips (U.K.) Limited SNS decommissioning survey. UKCS 48 and 49. Viscount VO, Vulcan UR and Vampire/Valkyrie OD (LOGGS). Decommissioning Environmental Report J/1/20/2342

Recommended Decommissioning Options

ConocoPhillips conducted a Comparative Assessment of the options for decommissioning of the infield pipelines for VDP1 and LDP1, as required under the Petroleum Act 1998. Table ii provides an overview of the recommended decommissioning option for the VDP1 and LDP1 infrastructure.

Table ii: Overview of selected decommissioning options of the VDP1 and LDP1 infrastructure

VDP1/ LDP1 Infrastructure	Selected Decommissioning Option	Proposed Decommissioning Method
Topsides	Full removal	Single lift either separately or together and transportation to shore by a Heavy Lift Vessel for dismantlement, disposal and recycling.
Jacket (and risers)		
Pipelines	Decommissioned *in situ*	Minimal intervention
Remaining mattresses and grout bags	Minimal disposal option (Decommissioned *in situ*)	
T-piece (LDP1 only)	Full removal	Cut and lift via a Dive Support Vessel with a supply vessel on site
Wells (and conductors)	Plug and Abandon	In accordance with the Oil and Gas UK Guidelines for the Suspension and Abandonment of Wells (2012)

Environmental Setting and Sensitivities

The VDP1 and LDP1 infrastructure is located in relatively shallow water (VDP1, 15 to 36 m and LDP1, 22 to 37 m) in the southern North Sea.

Sediments in the decommissioning areas comprise fine to course sands, often silty and with variable amounts of shell fragments and occasional pebbles and cobbles. The highly dynamic marine environment restricts the silt and clay content to less than 5%.

Side-scan sonar images from recent environmental surveys and historic pipeline monitoring surveys show evidence of exposure of the pipelines included in both DPs. This exposure is due to the presence of strong currents, relatively shallow water depths and mobile sediments which result in a dynamic seabed environment in the immediate area. These conditions have created seabed features such as sandbanks, megaripples, scour and shoal areas which are all characteristic of this area of the southern North Sea.

A key concern regarding the decommissioning of VDP1 and LDP1is that the infrastructure to be decommissioned are sited within the North Norfolk Sandbanks and Saturn Reef Site of Community Importance (SCI). This SCI has been designated for the protection of two Annex I habitats that have been identified within the SCI. These habitats include: ‘Sandbanks which are slightly covered by sea water all the time’ and ‘Reefs (specifically, the biogenic reef built from the tubes created by the polychaete worm *Sabellaria spinulosa*). The Joint Nature Conservation Committee has classified the SCI as representing good ‘conservation’ examples of these habitats.

Sabellaria spinulosa were identified in several historic survey reports within and adjacent to the VDP1 and LDP1 areas. Recent surveys carried out within 2 km of each of the VDP1 and LDP1 platforms observed only occasional, patchy, and fragmented areas of *Sabellaria spinulosa*; however these patches would not be classified as ‘reef’ under the Joint Nature Conservation Committees biogenic reef guidance.

Users of the VDP1 and LDP1 areas are mainly associated with oil and gas exploration and development, shipping and fishing. Tables iii and iv highlight the key physical,

chemical, biological and socioeconomic sensitivities relevant to the VDP1 and LDP1 areas.

Table iii: Summary of environmental characteristics and sensitivities

Aspect	Characteristics
Site overview	
The Viking VDP1 and LOGGS LDP1 infrastructure are located in Blocks 48/25, 49/16, 49/17 and 49/21 in the SNS.	
Conservation interests	
Offshore Annex I habitats	
North Norfolk Sandbanks and Saturn Reef SCI	The entire VDP1 and LDP1 infrastructure is located within this SCI. The sandbanks typically have fields of sand waves associated with them. The Annex I biogenic reef habitats formed by tube-building polychaete (*Sabellaria spinulosa*) are also present in the SCI.
Coastal conservation sites	
SACs	Two inshore SACs are located less than 70 km from the LDP1 infrastructure: • Overtrand Cliffs (57 km SW) • The Wash and North Norfolk Coast (62 km SW)
SPAs	There are two inshore SPAs located less than 70 km from LDP1 infrastructure: • The North Norfolk Coast (65 km SW) • The Outer Thames Estuary (68 km S)
No designated conservation sites (Marine Coastal Zones) coincide with the VDP1 and LDP1 facilities.	
Coastal and Offshore Annex II species	
Harbour porpoise (*Phocoena phocoena*)	Harbour porpoise have been reported to occur from February through May and again from August to October.
Bottlenose dolphins (*Tursiops truncatus*)	No bottlenose dolphins were recorded in the area.
Grey seals (*Halichoerus grypus*)	High numbers of grey seals are found around the mouth of the Humber and close to the Donna Nook National Nature Reserve. Grey seal density diminishes with distance offshore.
Common seals (*Phoca vitulina*)	High concentrations of common seals have been found in The Wash National Nature Reserve and are also likely to be found further offshore.
Plankton	
Plankton in the sea area surrounding VDP1 and LDP1 are likely to be typical for the SNS.	
Benthic environment	
Seabed sediments	Sediments in the decommissioning area are comprised of fine to coarse sands, often silty and with variable amounts of shell fragments and occasional pebbles and cobbles. The highly dynamic marine environment restricts the silt and clay content to less than 15 %. The seabed habitat when classified using the EUNIS code is *A5.2: "Sublittoral, clean medium to fine or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets".*
Benthic fauna	Benthic fauna identified during seabed surveys are typical for this area of the SNS. The shallow-water infaunal assemblage is typically characterised by taxa including polychaetes, bivalve molluscs and amphipods and crustaceans. *Sabellaria spinulosa* were identified in several historical survey reports within and adjacent to the SNS Phase 1 area. Recent surveys did observe some patchy fragmented areas of *Sabellaria spinulosa*, however these patches would not be classified as 'reef' under the JNCC *Sabellaria spinulosa* reef definition guidance.

Table iii (continued): Summary of environmental characteristics and sensitivities

Aspect	Months of the Year											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish* – spawning, juvenile and nursery areas (for the ICES Rectangles 35F1 and 35F2)***												
Mackerel (*Scomber scombrus*)	JN	JN	JN	JN	JNS*	JNS*	JNS*	JNS	JN	JN	JN	JN
Herring (*Clupea harengus)*	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN
Cod (*Gadus morhua*)	JNS	JNS*	JNS*	JNS	JN	JN	JN	JN	JN	JN	JN	JN
Whiting (*Merlangius merlangus*)	JN	JNS	JNS	JNS	JNS	JNS	JN	JN	JN	JN	JN	JN
Plaice (*Pleuronectes platessa*)	JNS*	JNS*	JNS	JN	JN	JN	JN	JN	JN	JN	JN	JN
Lemon sole (*Microstomus kitt*)	N	N	N	NS	NS	NS	NS	NS	NS	N	N	N
Sole (*Solea solea*)	JN	JN	JNS	JNS*	JNS	JN	JN	JN	JN	JN	JN	JN
Sandeel (*Ammodytidae sp*)	NS	NS	N	N	N	N	N	N	N	N	NS	NS
Sprat (*Sprattus sprattus*)	JN	JN	JN	JN	JNS*	JNS*	JNS	JNS	JN	JN	JN	JN
Nephrops (*Nephrops norvegicus*)	NS	NS	NS	NS*	NS*	NS*	NS	NS	NS	NS	NS	NS
Tope shark (*Galeorhinus galeus*)	N	N	N	N	N	N	N	N	N	N	N	N
Horse mackerel *(Trachurus trachurus)*	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN
Seabirds *(combined for the UKCS Blocks 48/20, 49/16, 49/17 and 49/21)*												
The most common species of seabird found in these areas of the SNS include: Fulmar, Gannet, Guillemot, Kittiwake, Razorbill, Puffin, Little Auk; as well as numerous species of gull, tern and skua.												
Seabirds vulnerability	3	2	1	2	3	4	ND	2	2	2	1	3
Marine mammals *(generalised for Quadrants 48 and 49)*												
Harbour porpoise		L	M	L	L			VH	H	L		
White-beaked dolphin	L			M	L					L		
White-sided dolphin								L				
Commercial fishing												
Moderate to low fishing activity occurs within the vicinity of the VDP1 and LDP1 facilities (ICES Rectangles 35F1 and 35F2). Netherlands and the UK are the two main nationalities that work in the area. The UK vessel activity is targeted closer inshore and consists primarily of potting vessels fishing for crab and lobsters. Dutch vessels primarily fish further offshore using beam trawlers targeting demersal species, including plaice. Based on VMS data there is little vessel activity in the immediate vicinity of the infield pipelines and platforms.												

KEY:

Fish area	
S	Spawning
S*	Peak spawning
J	Juvenile
N	nursery

Seabird vulnerability	
1	Very high
2	High
3	Moderate
4	Low
ND	No data

Marine mammal sightings	
VH	Very high
H	High
M	Moderate
L	Low
ND	No data

Table iv: Summary of socioeconomic characteristics and sensitivities

Aspect	Characteristics
Other users	
Shipping activity	Shipping activity in the area of the VDP1and LDP1 facilities ranges from very low to high.
Oil and Gas	The nearest non-ConocoPhillips field is the Leman Field and its 33 platforms, located approximately 4 km to the south.
Telecommunications	The Tampnet Telecommunications cable passes 200 m east of Viking DD.
Military activities	Ministry of Defence air combat training zones is partially located within the decommissioning area.
Aggregate extractions	Aggregate application, option and licence areas are located within the LDP1 area.
Windfarms	The nearest windfarms are Hornsea zone and East Anglia zone located approximately 35 km N and SE, respectively, from VDP1 and LDP1 facilities, and the Dudgeon windfarm site which is located approximately 36 km W of the LDP1 facilities.
Wrecks	No designated historical wrecks recorded in the area; however, there are nine non-designated wrecks, and seven of these are classified as dangerous wrecks.
Carbon capture storage (CCS)	The Viking CD, DD and GD platforms are located over or within 1 km of an aquifer with the potential for CCS in the southern North Sea.

Key Environmental Concerns

A risk assessment of the potential significant environmental impacts, between the proposed decommissioning activities and the local environment, identified a number of potential impacts requiring further assessment. The following summarises the conclusions from detailed assessments of the potential sources of significant impact.

Energy and emissions

Energy use and associated emissions resulting from the proposed decommissioning activities under VDP1 and LDP1are mainly attributed to the vessel and helicopter use. The cutting and lifting of the jacket and topsides will utilise the most number of vessels and therefore result in the highest energy usage and emissions.

The emissions from the decommissioning activities will only have a localised effect on air quality. The impact on air quality is unlikely to affect any sensitive receptors within the VDP1 and LDP1 area as the impact is expected to be limited to the immediate vicinity. For this reason, there is unlikely to be a significant transboundary or cumulative impact on air quality.

Underwater noise

Man-made underwater noise has the potential to impact on fish species and marine mammals. Several activities associated with the proposed decommissioning activities will generate underwater noise. Based on the activities proposed, it is estimated that the sound levels would attenuate to ambient levels within a few kilometres of the sound source.

As such, it is unlikely that the sound produced from decommissioning activities would have an effect on fish behaviour that would be noticeable at the population level given the limited spatial extent of the sound generated.

The main marine cetacean species that occur in the VDP1 and LDP1 areas are white-beaked dolphin, white-sided dolphin and harbour porpoise. There are two species of pinniped present, common seal and grey seal. Records indicate the seals will be in the study area at the same time as decommissioning activities are taking place. These species are all subject to regulatory protection form injury or disturbance.

Vessel noise is thought to be the main source of persistent noise during the decommissioning activities and a worst-case scenario was modelled using a maximum of eight vessels present at one location. Even with this worst-case approach, subsea noise levels 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 (approximately 9 to 100 m). The individual and cumulative impacts from the decommissioning activities at VDP1 and LDP1 were not considered significant.

Seabed impacts

The proposed decommissioning operations at the VDP1 and LDP1 areas will result in work being undertaken at or near the seabed. Therefore, there is the potential for localised long and short-term seabed disturbance. Surveys have indicated that there are no cuttings piles associated with the platforms to be removed under the two decommissioning programmes.

The short-term impacts associated with the decommissioning of the VDP1 and LDP1 infrastructure include excavation pits at the jacket piles, anchor pits and excavation work for access to the buried pipework. Studies have shown that any impact from seabed disturbance and anchoring will be transient in this area of the North Sea, and any anchor plough marks and excavation would revert to background seabed conditions in a short timescale. None of these impacts have been assessed as significant.

The decommissioning *in situ* of the pipelines, mattresses and associated grout bags, rock-placement on pipeline ends and the placement of rock on the seabed to provide stabilisation for the accommodation work vessel will constitute a long-term impact on the seabed. These impacts constitute a change in sediment type within the SCI however the footprint is small (0.62 km^2) in comparison to the total SCI area (3,603 km^2). ConocoPhillips has selected *in situ* decommissioning of the mattresses and grout as their preferential decommissioning option. This option results in reduced impacts to the SCI while maintaining pipeline stability as opposed to the placement of additional rock material which would result in a larger footprint.

The pipelines will release a small volume of contaminants to the marine environment over time as the pipeline degrades. However, these volumes will be small and over a long period (between 100 - 500 years depending on conditions). These levels are not likely to rise significantly above background levels or result in long-term toxicity to marine organisms or populations.

Societal impacts

The main socioeconomic impacts which may arise as a result of the decommissioning of the VDP1 and LDP1 include interference or disturbance to commercial shipping and/ or snagging hazards to fishermen resulting in lost or damaged fishing gear.

The majority of the decommissioning operations will be undertaken within the current safety exclusion zones which are in place around each of the decommissioned platforms.

The exception to this is a small number of surveys which will be undertaken along the pipelines decommissioned *in situ*. As a result there will be negligible impacts to commercial shipping activities in the vicinity.

The decommissioning of pipelines *in situ* will not result in any additional loss of fishing grounds as these pipelines have been *in situ* for a number of decades. There is potential for the small footprint of the mattresses and rock-placement left *in situ* becoming exposed over time and potentially posing a snagging hazard. Based on the level of fishing present in the VDP1 and LDP1 areas this risk is low. ConocoPhillips intends to minimise any potential risk to fishermen by accurately mapping the location of these potential obstructions and making these positions available to fishermen for navigational purposes. Once the decommissioning of the infrastructure is complete full overtrawlability trials will be conducted in the 500 m safety exclusion zones where stabilisation features predominantly exist and at locations where mattresses are identified, ensuring the infrastructure decommissioned *in situ* is passible by fishing gear.

Discharges to sea

There are not any significant discharges to sea planned from any of the decommissioning activities proposed under VDP1 and LDP1. All pipeline fluids are to be re-injected downhole and any residual solids, fluids within the topsides or filtered solids from the pipeline cleaning regime will be collected and shipped to shore for onshore disposal.

There is potential for some residual hydrocarbons and NORM scale to be present in the pipelines decommissioned *in situ* and a negligible amount of material during cutting of the pipelines will be discharged to sea. A small volume of material may be released to the environment over many decades as the pipeline degrades over time (100 to 500 years). However these are not likely to result in any significant impacts on the marine environment.

Accidental events

Accidental events, such as the release of hydrocarbons and chemicals, can result in a complex and dynamic pattern of pollution distribution and impact on the marine environment. 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 VDP1 and LDP1 areas would result from a loss of diesel from on-site vessels or collisions. Diesel spills will disperse and dilute quickly, with a very low probability of hydrocarbons reaching the coastline. The likelihood of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area. The current Oil Pollution Emergency Plans for the SNS Operations, Onshore Operations and the addendum for the well plug and abandonment programme provide effective spill management in the case of an accidental event.

During the proposed operations, there is the potential for the loss of objects dropped overboard which may present a hazard to shipping, fishing activities and may also impact the seabed community within the drop zone. Where practicable ConocoPhillips will endeavour to minimise the number of dropped objects and will secure items to prevent loss during the proposed decommissioning operations. The recovery of oil and gas related debris wherever practicable will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea.

Environmental Management

ConocoPhillips is committed to conducting activities in compliance with all legislation and operates an ISO14001 certified Environmental Management System (EMS). The EMS covers all aspects of ConocoPhillips's activities including exploration, drilling and production activities. All activities associated with the decommissioning of the VDP1 and LDP1 infrastructure will be covered by this EMS.

Conclusions

Overall, the Environmental Statement has evaluated the potential impacts, their significance and environmental risk reduction measures. Although the intent is to decommission several pieces of infrastructure *in situ*, this document concludes that ConocoPhillips have, or intend to, put in place sufficient safeguards to mitigate the potential environmental risk and to monitor the implementation of these measures. A summary of the impacts and planned mitigation measures are presented in Table v.

In addition, the Environmental Statement has highlighted the positive impact that the decommissioning of the VDP1 and LDP1 infrastructure will have on commercial fishermen and other users of the sea, with the opening of areas of the sea which have previously been excluded for safety reasons. This will exceed the small area of seabed which may be unavailable from the presence of mattresses and rock-placement decommissioned *in situ*.

Therefore, it is the conclusion of this Environmental Statement that the recommended options presented for the decommissioning of the VDP1 and LDP1 infrastructure can be completed without causing significant adverse impact to the environment.

Table v: Summary of potential impacts and planned mitigation measures

Potential Sources of Impact	Planned Mitigation Measures
Energy and Emissions	
CO_2 Emissions	• Vessels will be audited as part of selection and pre-mobilisation. • All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency. • Vessels will use ultra-low sulphur fuel in line with MARPOL requirements. • Work programmes will be planned to optimise vessel time in the field. • Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems.
Underwater Noise	
Underwater noise from decommissioning activities	• Machinery and equipment will be in good working order and well-maintained. • Helicopter maintenance will be undertaken by contractors in line with manufacturers and regulatory requirements. • The number of vessels utilising dynamic positioning would be minimised where possible.

Table v (continued): Summary of potential impacts and planned mitigation measures

Seabed Disturbance	
Subsea equipment cutting, excavation and lifting	• Cutting and lifting operations will be controlled by a remotely operated vehicle to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment. • The requirements for excavation of the platform footings 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.
Anchoring activities	• All anchors would be completely removed from the seabed at the end of the decommissioning operations.
Rock-placement	• A rock-placement vessel or Remotely Operated Vehicle Support Vessel will be used. The rock mass will be carefully placed over the designated areas of the pipelines and seabed by the use of fall pipe equipped with cameras, profilers, pipe tracker and other sensors as required. • The *in situ* decommissioning of the existing pipeline stabilisation material (mattresses, grout bags and rock) will prevent the need for additional rock-placement as support on pipelines to be decommissioned *in situ*. • The profiles of both the rock-placement over the pipeline ends and the accommodation work vessel rock berms will be such as to allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging of fishing gear. • Vessel orientation has been reviewed and selected to minimise the requirements for rock whilst allowing for the safe locating of the accommodation work vessel and access i.e. crane reach to undertake essential scopes of work.
Societal Impacts	
Physical presence of decommissioning vessels causing potential interference to other users of the sea.	• Prior to commencement of operations, the appropriate notifications will be made and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Appropriate navigation aids will be used to ensure other users of the sea are made aware of the presence of vessels.
Damage to or loss of gear as a result of subsea obstructions decommissioned *in situ*, posing potential snagging risks.	• The use of a fall pipe on the rock-placement vessel and the use of remotely operated vehicle during rock-placement operations will ensure that the rock was placed in the correct position. • On-going consultation with fisheries representatives • Subsea rock-placement will be included on navigational charts • Post-decommissioning seabed clearance and an overtrawlability survey to ensure that the rock-placement gradient is within acceptable limits.
Long term environmental impacts of the physical presence of the pipelines, mattresses and rock-placement on the seabed.	• Post decommissioning survey to accurately map the location of subsea structures decommissioned *in situ*. • Potential post-decommissioning monitoring (for up to10 years) of routes of the buried pipeline routes will be discussed as part of any future monitoring programme agreed with DECC. • Potential remedial intervention in the event issues arise with the pipeline interacting with other users. These mitigation measures recognise ConocoPhillips' indefinite liability for the pipeline and associated materials decommissioned *in situ*.

Table v (continued): Summary of potential impacts and planned mitigation measures

Discharges to Sea	
Residual hydrocarbons or solids in pipelines and subsea pipework	Cleaning of pipelines during the decommissioning process, including: • Flushing pipelines with sea water and gel pigging. • Re-injection of contaminated fluids from the pipelines. • Removal of any mobilised solid wastes for skip and ship. • Release of residual contaminants from the long term degradation of the pipelines decommissioned *in situ*. • Release of degradation products from the breakdown of the pipelines. Disposal of waste transported onshore for disposal will be provided by an approved waste management contractor, in compliance with ConocoPhillips existing standards, policies and procedures.
Residual fluids in piggybacked methanol lines	• Cleaning of pipelines during the decommissioning process. • A chemical risk assessment will be undertaken and operations permitted under the Offshore Chemicals Regulations 2002 (as amended). • Wherever possible recovered clean methanol will be reused during Viking decommissioning operations.
Accidental Events	
Dropped object event from VDP1 and LDP1 decommissioning activities	• Where practicable all efforts will be made by ConocoPhillips to minimise the number of dropped objects. During the cleaning and preparation for removals programme, items will be secured to prevent loss wherever practicable. • Post-decommissioning surveys will be undertaken to assess the presence and potential recoverability of any lost objects from VDP1 and LDP1 facilities wherever practicable. The recovery of such debris will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea wherever possible.

1.0 INTRODUCTION

Within the southern North Sea (SNS), ConocoPhillips (U.K.) Limited (ConocoPhillips) operates three main gas areas (Viking, Caister Murdoch System [CMS], and Lincolnshire Offshore Gas Gathering Systems [LOGGS]) (Figure 1.1). ConocoPhillips propose to decommission part of the Viking and LOGGS fields and facilities over a 10-year period (2014 to 2023). Decommissioning of the SNS hubs and satellites will be carried out in a phased manner.

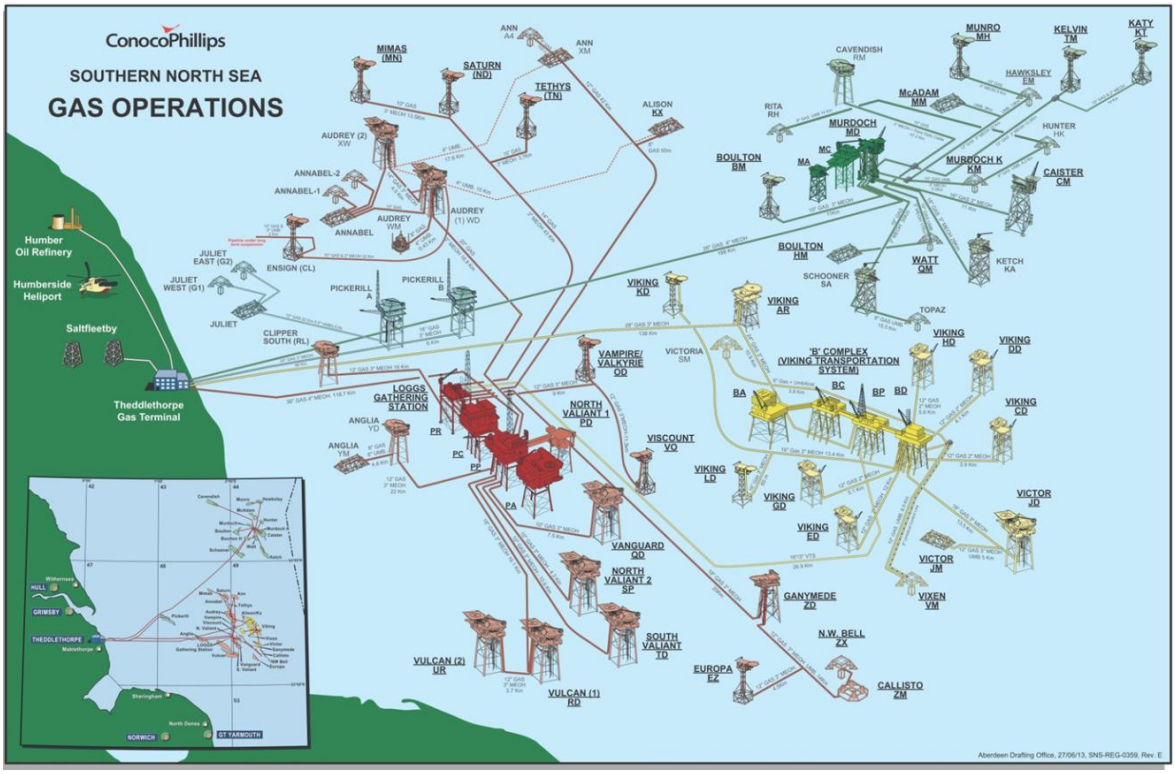


Figure 1.1: ConocoPhillips SNS gas operations

As part of the initial decommissioning phase, this Environmental Statement (ES) includes the first of two Environmental Impact Assessments (EIAs). This EIA will support two decommissioning programmes (DPs). The Viking Decommissioning Programme 1 (VDP1) will cover part of the Viking area infrastructure (Figure 1.2) and the LOGGS Decommissioning Programme 1 (LDP1) will cover LOGGS infrastructure (Figure 1.3). The infrastructure to be decommissioned and included as part of VDP1 and LDP1 is located in the United Kingdom continental shelf (UKCS) Blocks 48/25, 49/16, 49/17 and 49/21 and comprises 16 pipelines, eight satellite platforms and associated subsea structures and protection.

1.1 Viking Area Overview

The Viking area comprises eight gas fields (Viking A, Viking B, Viking C, Viking D, Viking E, Victor, Vixen and Victoria). The Viking gas fields are located in the SNS, approximately 130 to 150 km east of the Lincolnshire coast, in Blocks 49/16c and 49/17a.

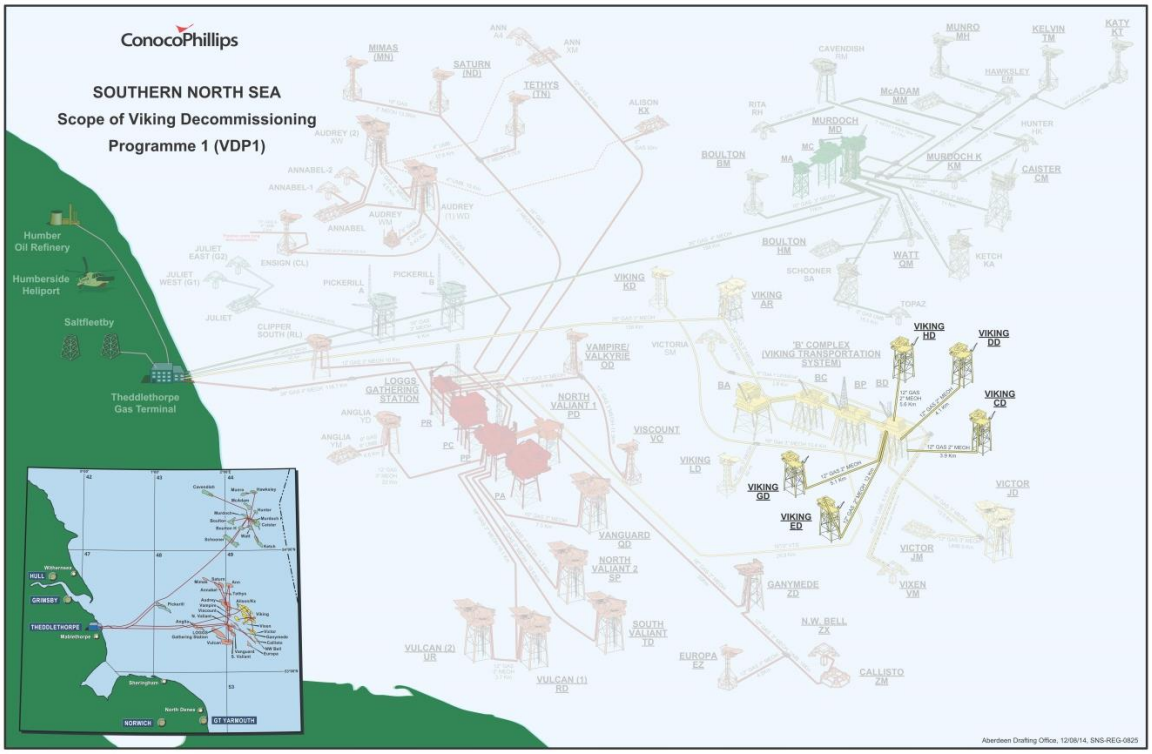


Figure 1.2: The Viking area infrastructure to be decommissioned under VDP1

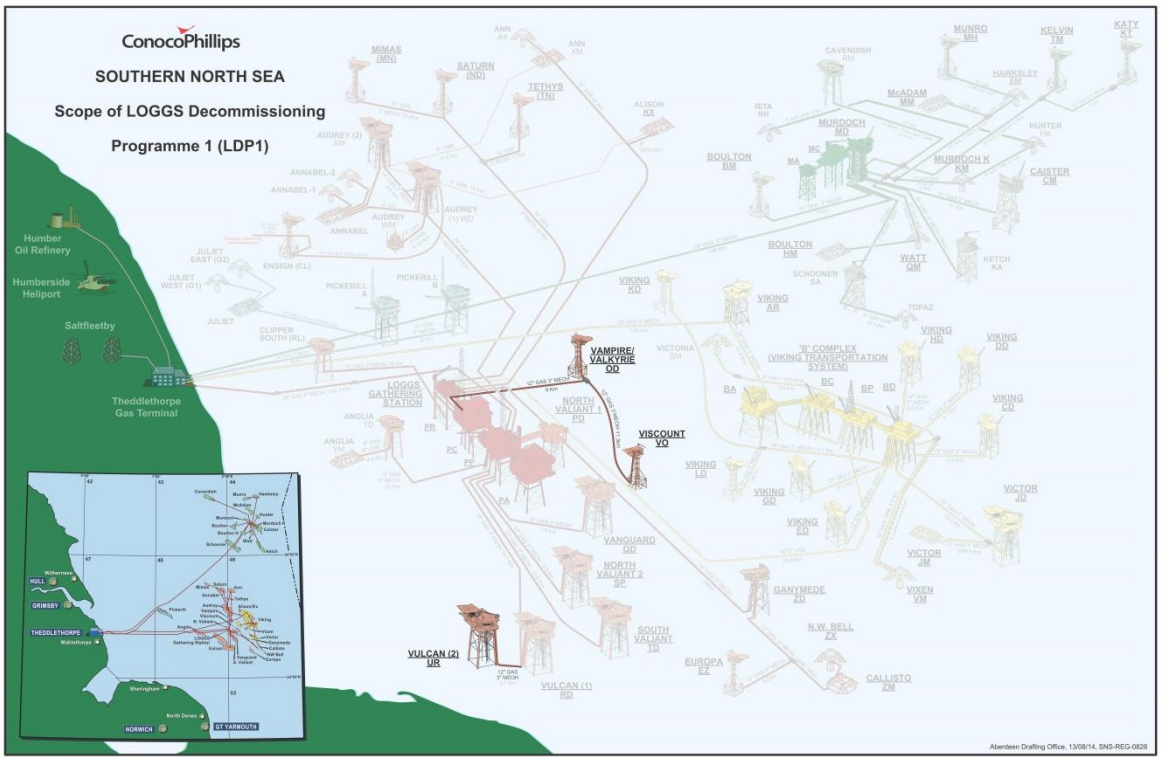


Figure 1.3: The LOGGS area infrastructure to be decommissioned under LDP1

The Viking area blocks were awarded to a Conoco led co-venture in the first North Sea licensing round in 1964. Development of the Viking area commenced in 1971 with installation of the Viking “A complex” and the 28” diameter pipeline ”Viking Transport System” (VTS) from Viking A to the onshore facilities at Theddlethorpe Gas Terminal (TGT). Production in the Viking area commenced in 1972. The Viking AD and FD wells were abandoned in 1996 and most of the A complex platforms were removed, leaving only the Viking AR riser platform and associated pipeline infrastructure. The Viking FD platform was also removed at this time.

The Viking area currently comprises four manned Viking “B complex” bridge-linked platforms, eight associated outlying wellhead satellite platforms, the Viking AR riser platform and associated subsea tiebacks. Gas from the Viking fields and other fields is tied back to the Viking B complex and exported to LOGGS, commingled with the gas from LOGGS, and then exported to the TGT via a 118.8 km 36-inch diameter export pipeline.

For VDP1, the ES covers decommissioning of the infrastructure in four of the Viking area gas fields (Viking A, B, C and D) comprising:

- Five infield satellite platforms, each comprising a topside and a jacket structure:
  - Viking CD;
  - Viking DD;
  - Viking ED;
  - Viking GD;
  - Viking HD;
- Ten infield pipelines (five gas and five piggybacked methanol);
- Fifteen platform based wells; and
- Associated mattress and grout bag protection.

1.2 LOGGS Area Overview

The LOGGS area comprises 16 gas fields (South Valiant, North Valiant, Vanguard, Vulcan, Vampire, Viscount, Valkyrie, Ganymede, Sinope, Europa, Callisto, NW Bell, Alison Kx, Saturn, Mimas, and Tethys). These fields are located in the SNS approximately 130 km east of the Lincolnshire coast in Blocks 48/09, 48/10, 48/20, 48/25, 49/11, 49/16, 49/17, 49/21, 49/22, and 49/23. The LOGGS area gas fields were discovered from 1970 onwards and production commenced in 1988.

For LDP1, the ES covers decommissioning of the infield infrastructure associated with three of the LOGGS area gas fields (Viscount, Vampire and Vulcan) comprising:

- Three infield satellite platforms, each comprising a topside and a jacket structure:
  - Vampire/ Valkyrie OD;
  - Viscount VO;
  - Vulcan UR;
- Six infield pipelines (three gas and three piggybacked methanol);
- T-piece (subsea structure);
- Fourteen platform based wells; and

- Associated mattress and grout bag protection.

1.3 Purpose of the Environmental Impact Assessment

Environmental impact assessment is a systematic process that considers how a project will change existing environmental conditions, and assesses the consequence and significance of such changes (Table 1.1). It 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.

The purpose of the EIA process is to understand and communicate the significant environmental impacts associated with the project options to inform the decision making process (see Section 2 below). To support VDP1 and LDP1, the EIA process was conducted in accordance with the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended). The ES presents the findings of the EIA and has been prepared as part of the planning and consents process for the decommissioning of the VDP1 and LDP1 facilities.

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 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 Statement (ES)	Reporting of the EIA process through production of an ES that clearly outlines the above processes. The ES provides a means to communicate the environmental considerations and environmental management plans associated with the project to the public and stakeholders.
Monitoring	Project impacts will be monitored during the operational phase of the project to verify that impact predictions are consistent with the subsequent outcomes.

1.4 Regulatory Context

The decommissioning of offshore oil and gas infrastructure in the UKCS is principally governed by the Petroleum Act 1998, as amended by the Energy Act 2008. The Petroleum Act sets out the requirements for a formal Decommissioning Programme which must be approved by the Department of Energy and Climate Change (DECC) before the owners of an offshore installation or pipeline may proceed.

At present there is no statutory requirement to prepare an ES for decommissioning. However, under the *Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998* (DECC Guidance Notes) the Decommissioning Programme must be supported by an EIA.

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

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

In addition, DECC have advised the Oil and Gas Industry that under the Marine and Coastal Access Act 2009 (MCAA) and the Marine (Scotland) Act 2010, an EIA/ ES will be required for all licence 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 tonnes must be completely removed for re-use, recycling or disposal on land. Any piles securing the jacket to the seabed should be cut below the natural seabed level at a depth that will ensure they remain covered. The depth of cutting is dependent upon the prevailing seabed conditions and currents (DECC, 2011a).

OSPAR Decision 98/3 does not include the decommissioning of pipelines. 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 DECC 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 comparative assessment (CA) made. Further regulatory drivers relevant to VDP1 and LDP1 are provided in Appendix A.

1.5 Report Structure

The structure for this VDP1 and LDP1 Decommissioning ES is detailed in Table 1.2.

Table 1.2: The VDP1 and LDP1 decommissioning ES structure

Section	Contents
Non-Technical Summary	A non-technical summary of the ES.
1. Introduction	An introduction to the project and the scope of the ES.
2. Methodology	The methodological approaches used in the EIA process and a summary of the supporting reports and studies undertaken.
3. Project Description	A description of the decommissioning options and the recommended decommissioning option determined by a formal CA process.
4. Environmental Description	A description of the environmental and sensitive receptors in the vicinity of the project area.
5. Consultation	Details of the consultation process.
6. Risk Assessment	A detailed description of the risk assessment approach and findings.
7. Energy and Emissions	Identification of potential sources of impact to environmental and societal receptors, cumulative and transboundary impacts, and details of practicable mitigation strategies.
8. Underwater Noise	
9. Seabed Footprint	
10. Societal Impact	
11. Discharges to Sea	
12. Accidental Events	
13. Waste	Details the waste likely to be generated and the management processes to be implemented during decommissioning activities.
14. Environmental Management	A description of ConocoPhillips environmental management procedures and how these will apply to the decommissioning of the VDP1 and LDP1 facilities. This section also includes a register of commitments made within the ES.
15. Conclusions	Key findings and conclusions.
16. References	Sources of information used to inform the assessment.
Appendix A: Legislation	A summary of relevant environmental legislation.
Appendix B: Baseline Environmental Survey Technical Note	A summary of the baseline environmental surveys undertaken in the Viking and LOGGS areas prior to decommissioning: supports Environmental Baseline (Section 4).
Appendix C: Non-Signifiant Impacts	A summary of the non-significant impacts.
Appendix D: Energy Use and Atmospheric Emissions Supporting Information	Additional information to support the Energy Use and Atmospheric Emissions Assessment (Section 7).
Appendix E: Underwater Noise Supporting Information	Additional information to support the Underwater Noise Assessment (Section 8).
Appendix F: Surrounding infrastructure in the North Norfolk Sandbanks and Saturn Reef Site of Community Interest (SCI).	A summary of the surrounding infrastructure which is situated within the North Norfolk Sandbanks and Saturn Reef SCI. Supports Seabed Footprint assessment (Section 9).

2.0 METHODOLOGY

The EIA systematically identifies significant environmental impacts and risks (potential impacts) associated with the project and assesses the requirement for impact/ risk mitigation measures. The objective of the EIA process is to incorporate environmental considerations into project planning and design to ensure that best environmental practice is achieved.

This section of the ES describes the methods used to:

- Identify and evaluate the potential environmental (including social) impacts arising from the decommissioning of the VDP1 and LDP1 facilities;
- Ensure an appropriate level of assessment is applied to the identified impacts, particularly those impacts identified as being significant; and,
- Identify actions needed, through design or management control, to avoid or mitigate the key anticipated impacts.

2.1 Environmental Impact Assessment Process

An overview of the EIA process to identify and assess the impacts associated with VDP1 and LDP1 is provided within Table 1.1 (Section 1.3) and Figure 2.1.

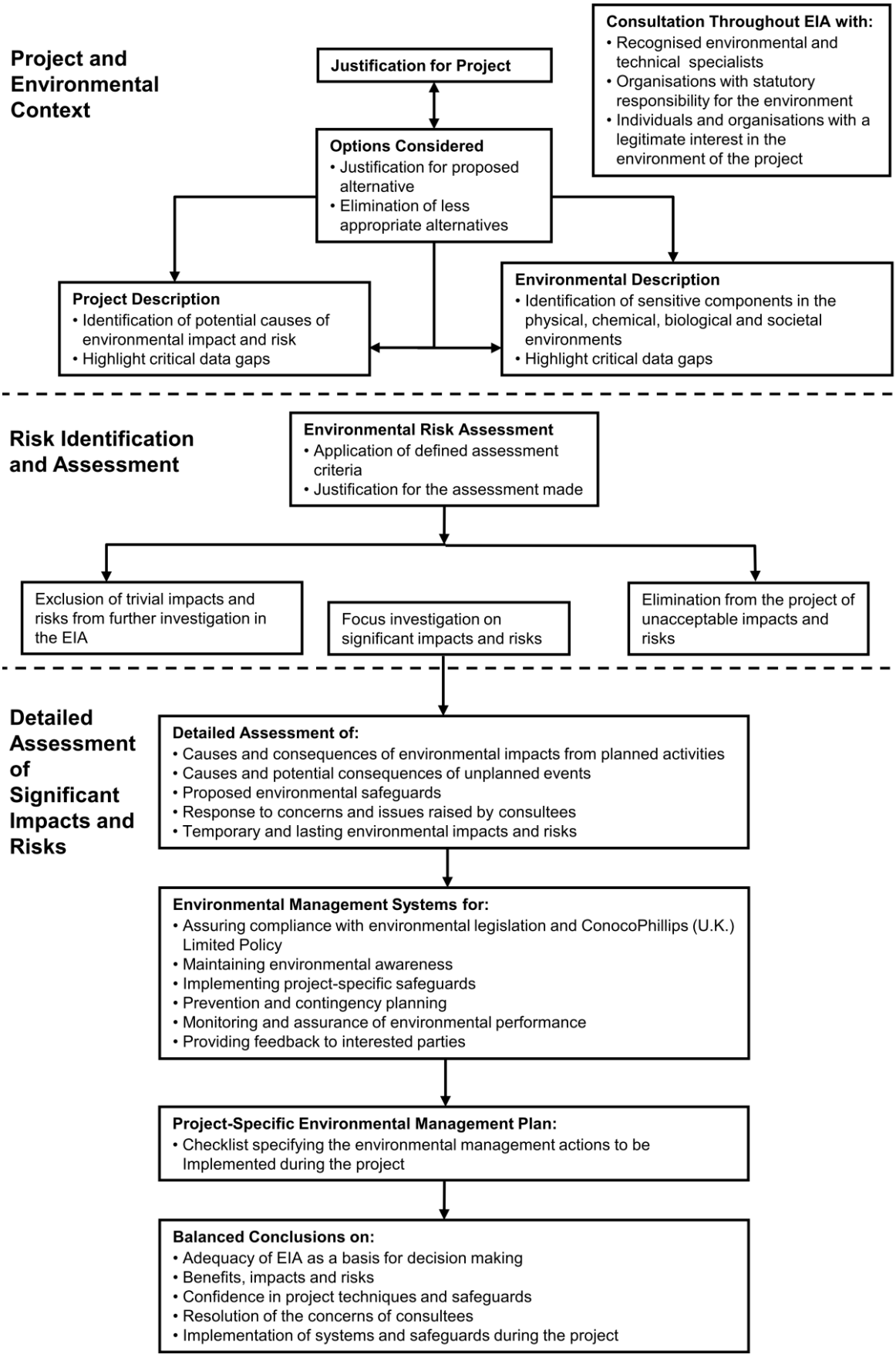


Figure 2.1: Principal stages in the EIA process

2.1.1 Scoping

Scoping is an integral part of the impact assessment process, the aim of which is to identify potential impacts to be assessed in greater detail within the ES. Scoping is a two-stage process comprising:

- An initial identification of potential impacts, and
- A preliminary evaluation of significance based on available information.

An internal Scoping Assessment was undertaken as part of the EIA and it identified the potential environmental receptors and other considerations which may be impacted by the proposed decommissioning operations (Figure 2.2).

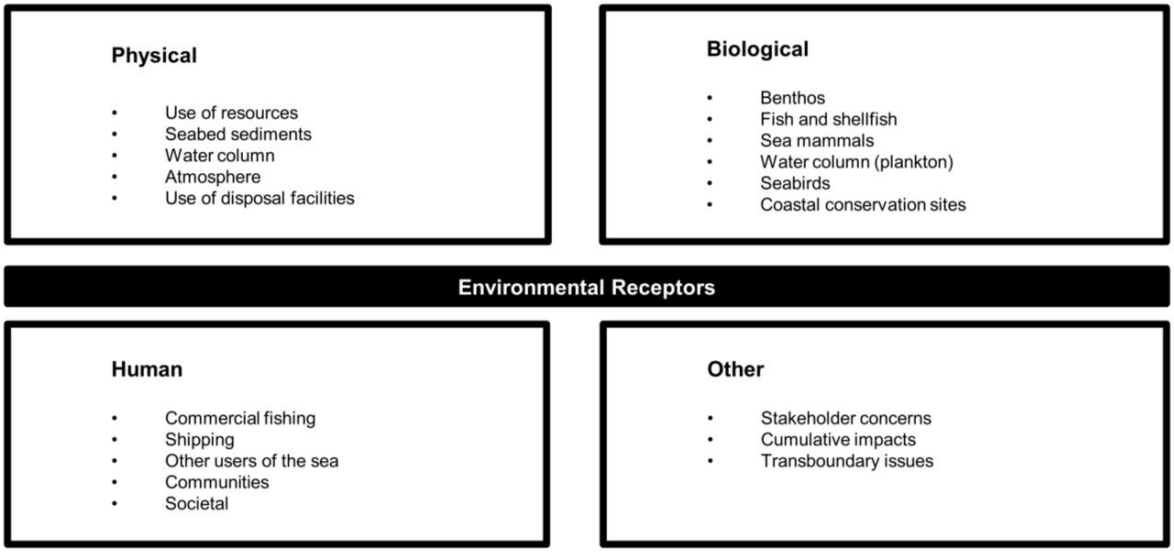


Figure 2.2: Environmental receptors

The activities identified during the scoping exercise as having the potential to give rise to significant environmental impacts and requiring further assessment during the EIA have been grouped into the following potential impacts:

1. Physical presence of vessels
2. Seabed disturbance
3. Energy use and atmospheric emissions
4. Underwater noise
5. Nearshore and onshore dismantling
6. Cleaning of marine growth
7. Landfill disposal
8. Safety risk to fishing
9. Socio-economic impact
10. Non-routine events
11. Cumulative impacts.

The above issues were further validated and assessed through baseline assessments, modelling studies, and stakeholder engagement.

2.1.2 Cumulative and transboundary impacts

The EIA process also includes the identification of any potential cumulative or transboundary impacts that could be caused by the proposed decommissioning programme when considered alongside other activities. Owing to the locality of the infrastructure, within the North Norfolk Sandbanks and Saturn Reef SCI, the impact of other activities in the area including non-oil and gas activities are addressed. Cumulative

impacts occur as a result of a number of activities (e.g., discharges or emissions) combining or overlapping and potentially creating new and/ or increased impacts. Even where impacts do not overlap, it is important to consider the incremental effect of many small areas of impact on a particular environment or its use.

Transboundary impacts are those which could have an impact on the environment and resources beyond the boundary of UK waters. The *Convention on Environmental Impact Assessment in a Transboundary Context* (Espoo, 1991) addresses the need to enhance international co-operation in assessing transboundary environmental impacts.

2.2 Comparative Assessment

The VDP1 and LDP1 pipelines are subject to a Comparative Assessment (CA) to identify the optimal decommissioning solution under the Petroleum Act 1998. In order to determine the recommended decommissioning option for the pipelines, ConocoPhillips conducted a formal CA of possible decommissioning options to establish whether there were significant differences between the options and if so which option performed the best.

Each decommissioning option was assessed against the five DECC criteria:

- Safety.
- Environment.
- Cost.
- Technical.
- Societal.

All pipeline decommissioning options, including the subsequent selected option, are described in Section 3. Sections 7 through 12 provide the impact assessment for the decommissioning option as recommended by the CA process.

3.0 PROJECT DESCRIPTION

This section presents a description of the alternatives considered for the decommissioning of the VDP1 and LDP1 facilities (Figure 3.1), including the selected option and associated activities.

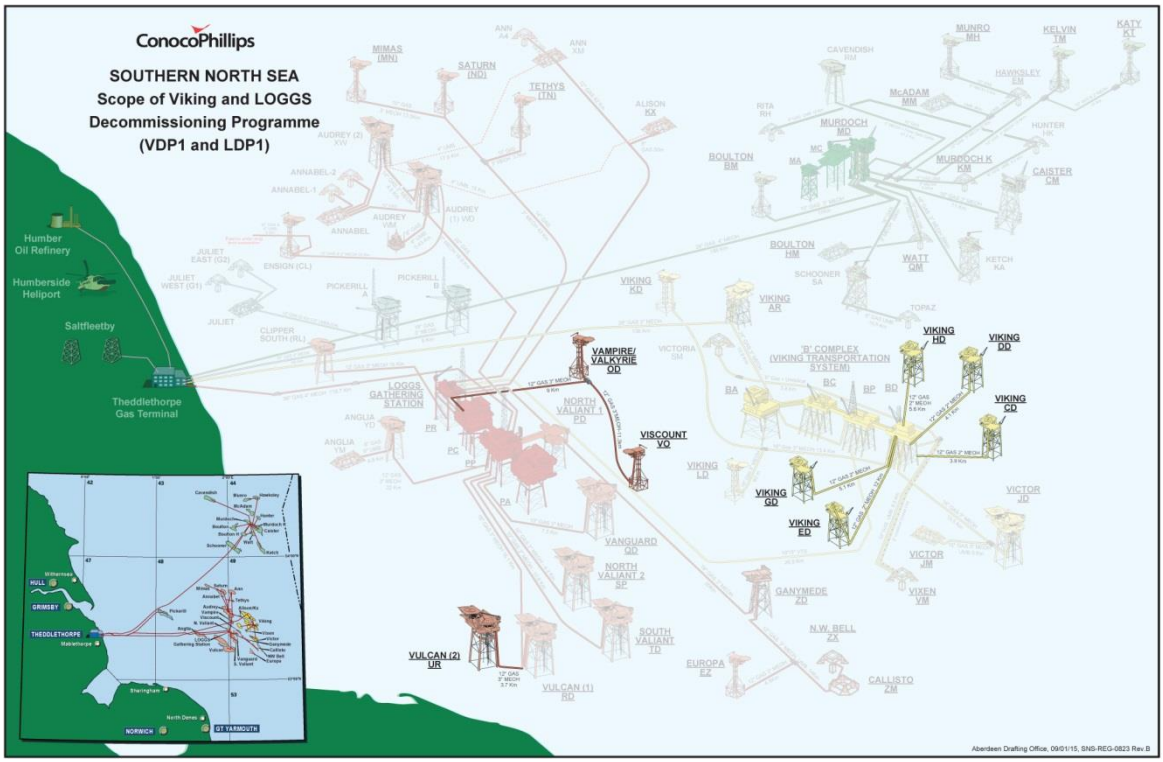


Figure 3.1: Infrastructure to be decommissioned under VDP1 (shown in yellow) and LDP1 (shown in red)

3.1 Overview

Sections 3.1.1 and 3.1.2 describe the facilities located in the Viking and LOGGS areas, respectively (Figures 3.2 and 3.4), and provide a brief overview of the production history of each area. The specific facilities to be decommissioned under VDP1 and LDP1 are also described in the relevant sections (VDP1 in Figure 3.3 and LDP1 in Figure 3.5).

3.1.1 Viking area

Development of the Viking area gas fields commenced in 1971 with the installation of the Viking A complex and the 28” diameter pipeline from Viking A to the onshore TGT. Production commenced in 1972. In 1996, the Viking AD and FD wells were abandoned and the majority of the A complex platforms and the Viking FD platform were removed, leaving only the Viking AR riser platform. The Viking area currently comprises the following infrastructure presented in Table 3.1 and is illustrated in Figure 3.2.

Table 3.1: Viking area infrastructure

Four platforms		
• Viking BD • Viking BA	• Viking BC	• Viking BP
Eight satellite platforms		
• Viking CD • Viking DD • Viking ED	• Viking HD • Viking LD • Viking GD	• Viking KD • Victor JD
Viking AR riser platform		
Three subsea manifolds		
• Vixen VM	• Victor JM	• Victoria SM
Twenty eight pipelines		
Thirty five wells (including subsea wells)		

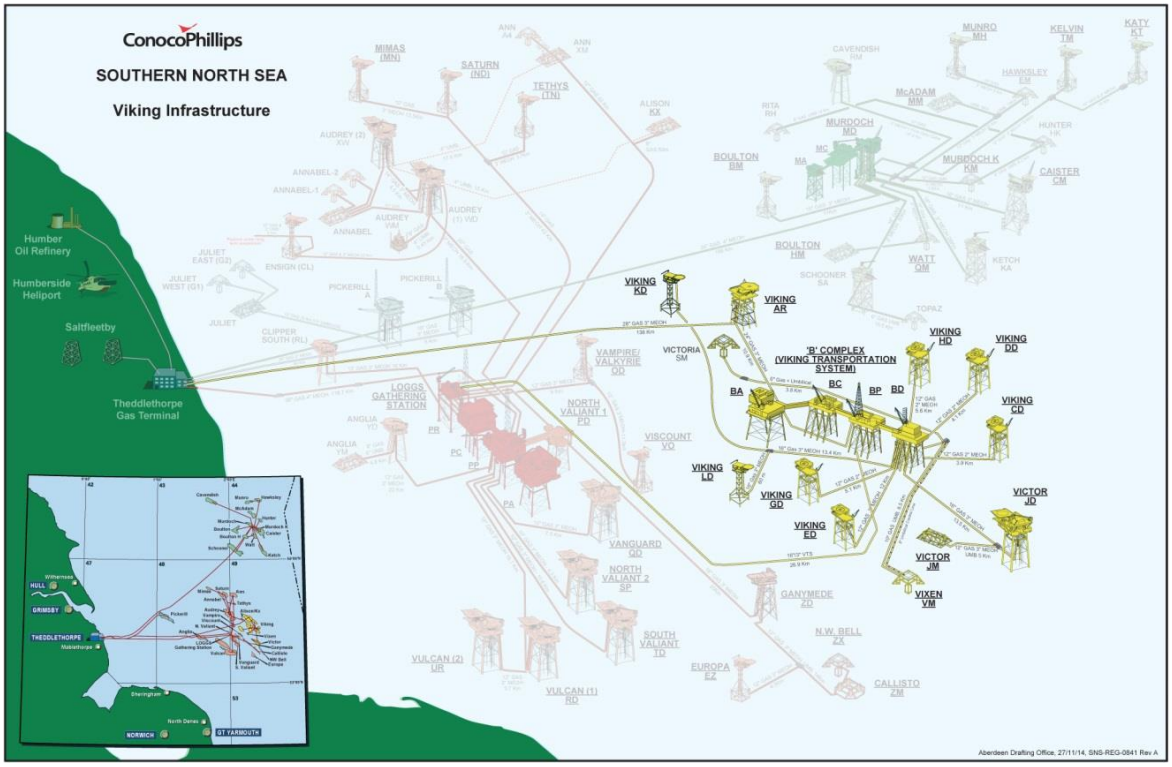


Figure 3.2: Viking area infrastructure

The Viking infrastructure being decommissioned under VDP1 includes the following and is illustrated in Figure 3.3 below:

- Five infield satellite platforms, each comprising a topside and a jacket structure:
    1. Viking CD;
    2. Viking DD;
    3. Viking ED;
    4. Viking GD;
    5. Viking HD;

- Ten infield pipelines (five gas and five piggybacked methanol); and,
- Fifteen platform based wells.

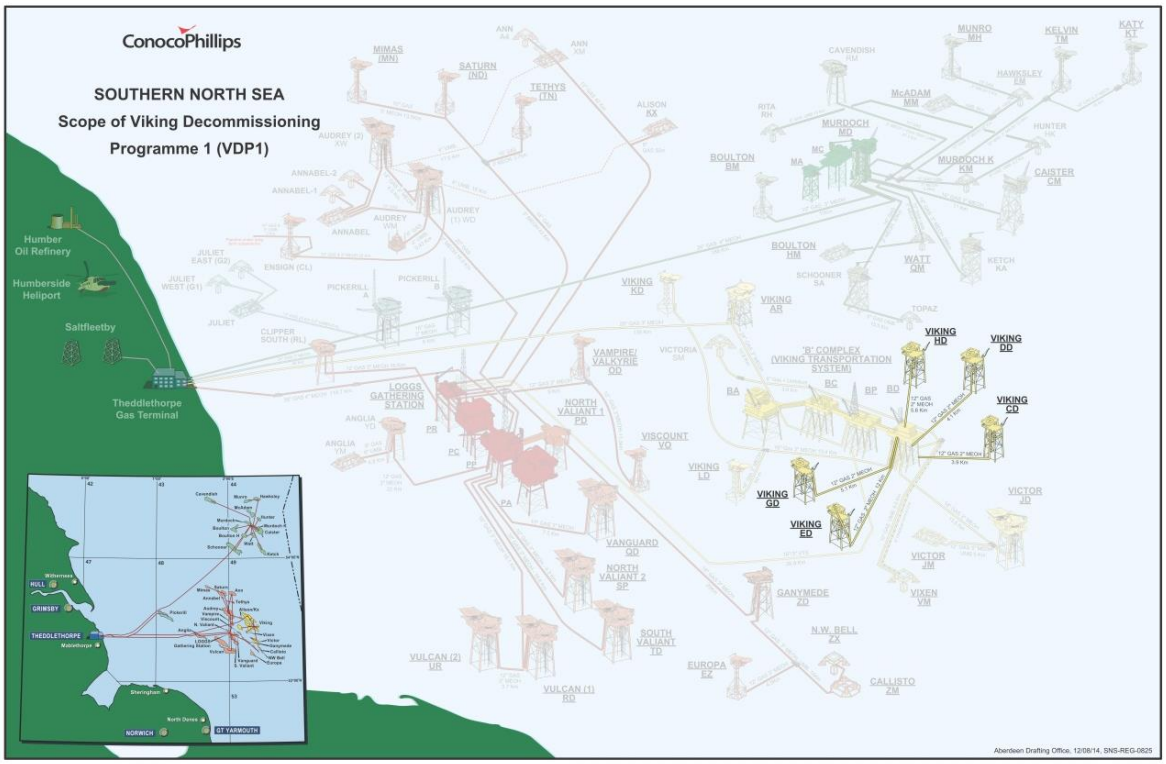


Figure 3.3: The Viking area infield infrastructure to be decommissioned under VDP1

3.1.2 LOGGS area

ConocoPhillips' Lincolnshire Offshore Gas Gathering System (LOGGS) development consists of a single 'gas gathering' complex which collects gas from a total of 18 'satellite' platforms and 10 subsea centres.

The LOGGS area comprises 16 gas fields (South Valiant, North Valiant, Vanguard, Vulcan, Vampire, Viscount, Valkyrie, Ganymede, Sinope, Europa, Callisto, NW Bell, Alison KX, Saturn, Mimas, and Tethys). These fields are located in the SNS approximately 130 km east of the Lincolnshire coast in Blocks 48/09, 48/10, 48/20, 48/25, 49/11, 49/16, 49/17, 49/21, 49/22, and 49/23. The LOGGS area gas fields were discovered from 1970 onwards and production commenced in 1988.

The initial development of LOGGS Installation consisted of an Accommodation Platform, Production Platform and North Valiant PD wellhead platform.

Further developments have included installation of a Compression Platform (1988) for transportation of gas to the shore Terminal and a Riser Platform (1993) to accommodate additional small developments from the subsea Ann wellhead, Ganymede platform, Callisto subsea development and now with Europa, Vampire, Viscount, Saturn, Mimas, Tethys, NW Bell and Clipper South.

The LOGGS area comprises the following infrastructure listed in Table 3.2 and is illustrated in Figure 3.4.

Table 3.2: LOGGS area infrastructure

Four platforms		
• North Valiant 1 PR • North Valiant PC	• North Valiant PP	• North Valiant PA
Eighteen satellite platforms		
• Mimas MN • Saturn ND • Tethys TN • Audrey 1 WD • Audrey 2 XW • Ensign CL	• Clipper South RL • Anglia YD • Vampire/ Valkyrie OD • Viscount VO • Vanguard QD • North Valiant 1 PD	• North Valiant 2 SP • South Valiant TD • Vulcan RD • Vulcan UR • Ganymede ZD • Europa EZ
Forty nine pipelines		
One hundred and three wells		

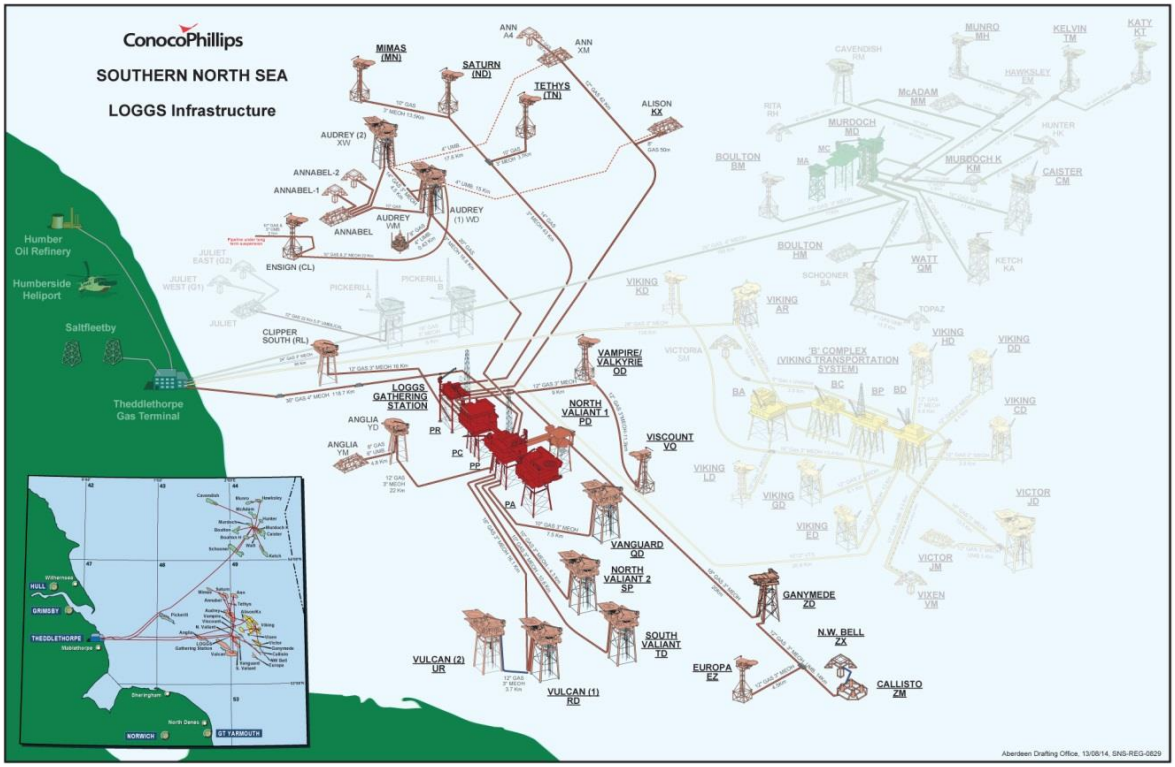


Figure 3.4: LOGGS area infrastructure

The LOGGS infrastructure being decommissioned under LDP1 includes the following and is illustrated in Figure 3.5 below:

- Three infield satellite platforms, each comprising a topside and jacket structure:
    1. Vampire/ Valkyrie OD
    2. Viscount VO
    3. Vulcan UR
- Six infield pipelines (three gas and three piggybacked methanol);
- T-piece (subsea structure); and
- Fourteen platform based wells.

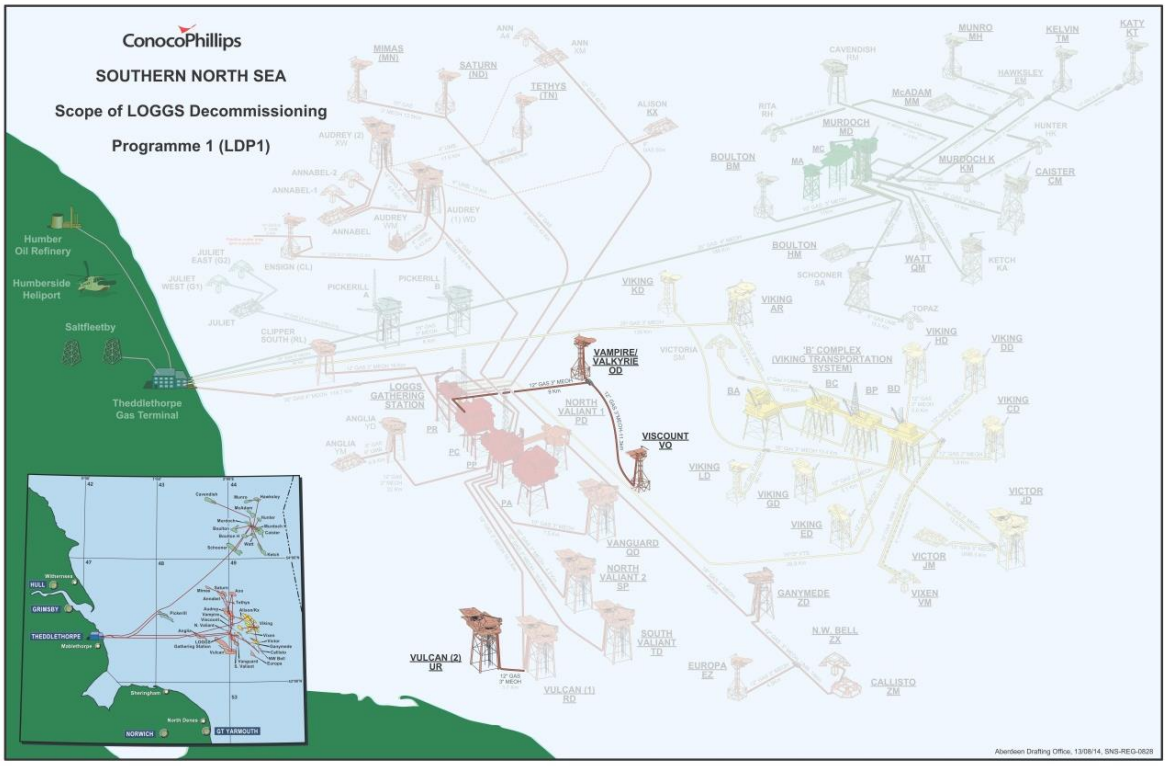


Figure 3.5: The LOGGS area infield infrastructure to be decommissioned under LDP1

3.2 Consideration of Alternative Use for the VDP1 and LDP1 Facilities

Most of the VDP1 and LDP1 facilities being decommissioned are obsolete and/ or in a degraded condition and so not suitable for safe re-use. The dismantling contractor will market any items of platform equipment (e.g., valves) suitable for alternative use. Two platform topsides (Vampire OD and Viscount VO) are more modern and may accordingly be candidates for larger-scale or complete re-use by other operators.

3.3 Scope of the Proposed Decommissioning Operations

The main elements of VDP1 and LDP1 include the following.

- Plug and abandonment (P&A): P&A of wells in accordance with a well abandonment programme (This is covered by a separate environmental assessment conducted for the Well P&A works).
- Final cleaning and preparation for removal of mobile hydrocarbons and chemicals from pipelines and topsides (gas, methanol and corrosion inhibitor) and subsequent flooding of pipelines with seawater (decommissioned *in situ*).
- Preparation of infrastructure for removal by specialist contractors to an approved onshore disposal facility.
- Leaving installations in cold suspension with appropriate navigational aids for up to two years.
- Removal of infrastructure by heavy lift vessel (HLV).
- Dismantling and disposal of infrastructure to be removed at an onshore reception facility.

The decommissioned structures, which are removed, will be taken to an appropriate onshore disposal yard located within Europe. Disposal yard selection remains to be made.

3.4 Description of the VDP1 and LDP1 Facilities

VDP1 and LDP1 cover the decommissioning of five Viking and three LOGGS unmanned satellite platforms, ten Viking and six LOGGS infield pipelines, 15 Viking and 14 LOGGS wells, and LOGGS subsea T-piece and associated mattresses and grout bags. Each platform comprises a topside and a jacket structure.

3.4.1 Platforms

Figure 3.6 presents the schematics of the five Viking platforms to be decommissioned under VDP1.

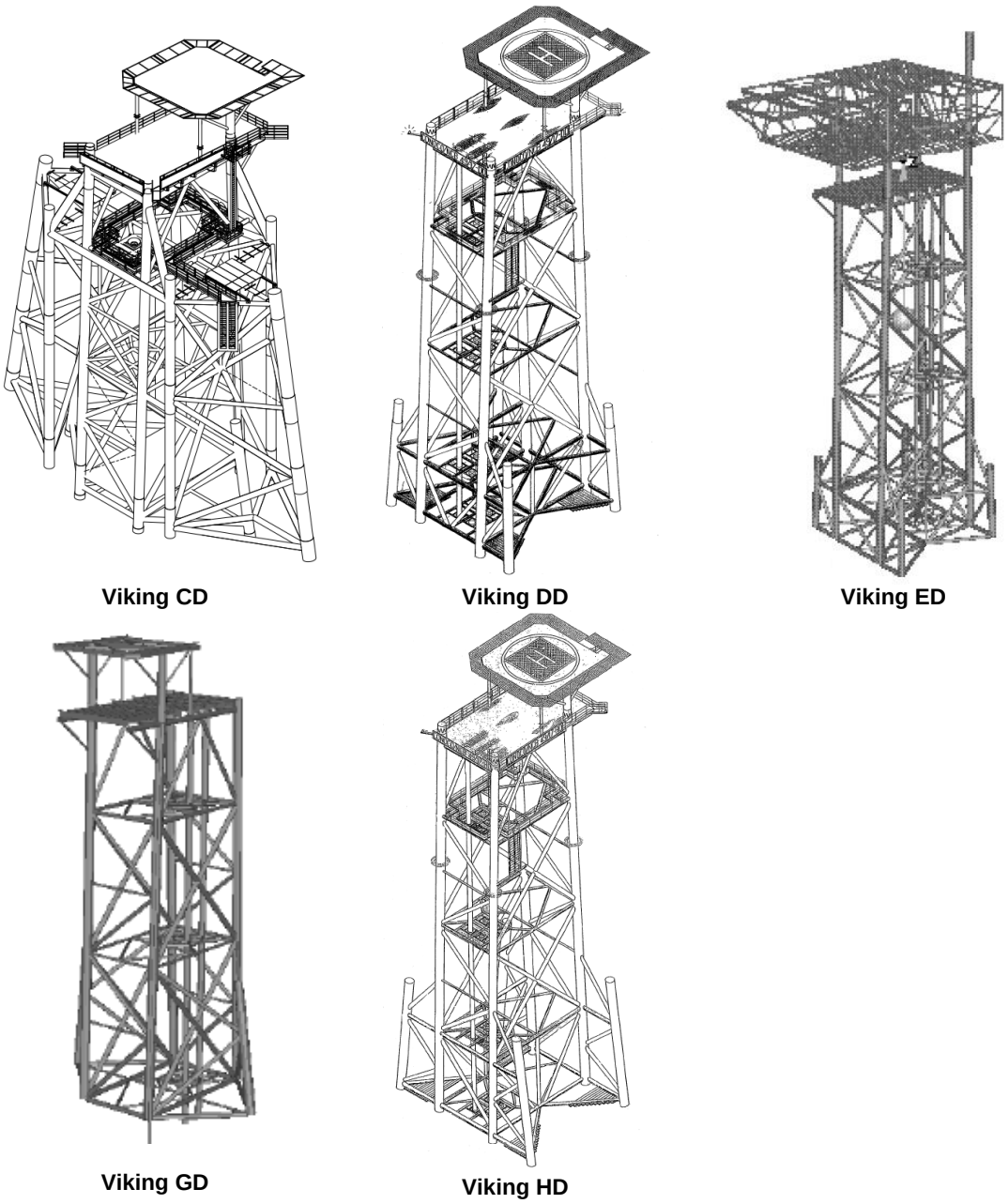


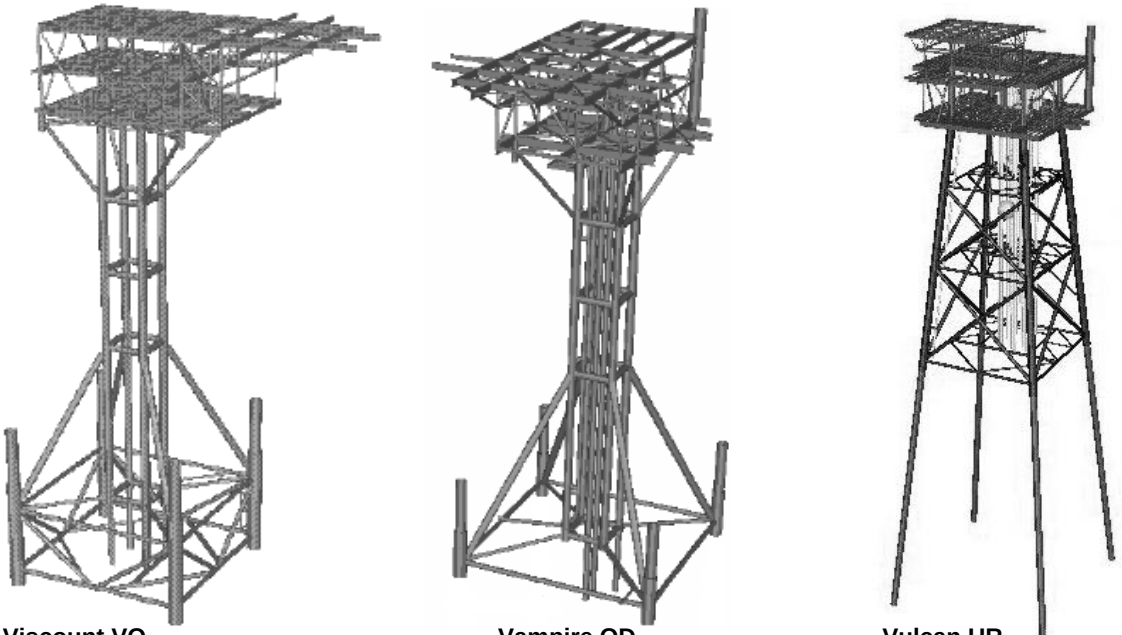
Figure 3.6: Schematics of the VDP1 satellite platforms to be decommissioned

The status and locations of the five VDP1 unmanned, fixed steel satellite platforms are outlined in Table 3.3.

Table 3.3: VDP1 satellite platforms to be decommissioned

Platform	Installed	Current status	Latitude; Longitude	Easting; Northing
Viking CD	1974	Production shut-in 2011	53°25'26.527"N; 02°22'36.348"E	458 583.441 E; 5 919 740.964 N
Viking DD	1974	Production shut-in 2010	53°26'30.906"N; 02°23'42.733"E	459 825.796 E; 5 921 728.293 N
Viking ED	1974	Cessation of production application submitted Q1 2015	53°26'01.946"N; 02°09'16.430"E	443 830.74 E; 5 920 995.85 N
Viking GD	1974	Production shut-in 2002	53°26'53.788"N; 02°15'52.420"E	450 601.698 E; 5 922 522.691 N
Viking HD	1974	Production shut-in 2011	53°26'53.788"N; 02°19'32.787"E	455 272.282 E; 5 927 939.991 N

Figure 3.7 presents the schematics of the three LDP1 platforms to be decommissioned.



Viscount VO **Vampire OD** **Vulcan UR**

Figure 3.7: Schematics of the LDP1 satellite platforms to be decommissioned

The status and locations of the three LDP1 unmanned, fixed steel satellite platforms are outlined in Table 3.4.

Table 3.4: LDP1 satellite platforms to be decommissioned

Platform	Installed	Current status	Latitude; Longitude	Easting; Northing
Viscount VO	2002	Producing	53°23'13" N; 02°08'59.6" E	443 459.2E; 5 915 773.63N
Vampire OD	1999	Producing	53°27'57" N; 02°02'33" E	436 435.31E; 5 924 645.36N
Vulcan UR	1998	Production ceased in 2012	53°15'29" N; 01°58'18" E	431 398.05E; 5 901 597.87N

3.4.2 Topsides

Each of the eight satellite platforms to be decommissioned under VDP1 and LDP1 may require the removal of the topside structure from their jacket structures; this will be dependent on the removals contractor selected.

The weights for the VDP1 and LDP1 topside structures are presented in Tables 3.5 and Table 3.6 below, respectively. The topside weights are based on net weights provided by the D3 Materials Inventory database (D3, 2014).

Table 3.5: Topside details of the VDP1 satellite platforms to be decommissioned

Platform	Topsides weight (tonnes)
Viking CD	173
Viking DD	171
Viking ED	410
Viking GD	164
Viking HD	165

Table 3.6: Topside details of the LDP1 satellite platforms to be decommissioned

Platform	Topsides weight (tonnes)
Viscount VO	331
Vampire OD	346
Vulcan UR	916

3.4.3 Jackets

Each of the eight satellite platforms (and risers) to be decommissioned under VDP1 and LDP1 will require the removal of the jacket structures from the seabed. Each jacket structure is secured to the seabed by piles. All piles securing the eight jackets will be cut below the natural seabed level at a depth that will ensure they remain covered. The depth of cutting is dependent upon the prevailing seabed conditions and currents (DECC, 2011a). ConocoPhillips are estimating this to be in the region of 3.0 m below the natural seabed level (ConocoPhillips, 2013).

Tables 3.7 and 3.8 below present the weights, number of legs and piles, and footing dimensions for the jacket structures to be decommissioned under VDP1 and LPD1, respectively. The weights are based on net weights provided by the D3 Materials Inventory database (D3, 2014). The weights presented are “as built” and do not account for marine growth weight.

Table 3.7: Jacket details of the five satellite platforms to be decommissioned under VDP1

Platform	Jacket			
	Weight (tonnes)	Number of legs	Number of piles	Dimensions of footing (m)
Viking CD	1,185	10	12	34 x 16
Viking DD	756	4	8	17 x 15
Viking ED	752	4	8	17 x 15
Viking GD	585	4	6	23 x 15
Viking HD	743	4	8	21 x 16

Table 3.8: Jacket details of the three satellite platforms to be decommissioned under LDP1

Platform	Jacket			
	Weight (tonnes)	Number of legs	Number of piles	Dimensions of footing (m)
Viscount VO	731	1	4	20 x 20
Vampire OD	587	1	4	22 x 22
Vulcan UR	1,138	4	4	26 x 26

3.4.4 Pipelines and subsea structures

Ten VDP1 infield pipelines (five gas lines and five piggybacked methanol lines) and the six LDP1 infield pipelines (three gas lines and three piggybacked methanol lines) are to be decommissioned. The VDP1 pipelines will be cut at their respective satellite platform end however the ends terminating at the Viking BD platform will be left connected because the Viking BD platform is operational. The LOGGS pipelines from Vampire OD to LOGGS PR, and Vulcan UR to Vulcan RD will only be cut at the satellite platform end; both Vampire OD and Viscount VO platforms are being removed and so pipelines PL1962 and PL1963 will be cut at both ends.

Detail for the VDP1 Pipelines

Table 3.9 summarises the pipelines to be decommissioned under VDP1. All VDP1 gas pipelines are piggybacked by the methanol lines. Table 3.10 provides 2011 to 2012 survey findings for exposure and spanning of the pipelines.

Table 3.9: VDP1 pipelines to be decommissioned

From	To	Installed	Type	Diameter (inches)	Length (km)	Pipeline number
Viking BD	Viking CD	1974	Gas	12	3.9	PL0089
			Methanol	2	3.9	PL0132
Viking BD	Viking DD	1974	Gas	12	4.1	PL0090
			Methanol	2	4.1	PL0131
Viking BD	Viking ED	1975	Gas	12	12.0	PL0091
			Methanol	2	12.0	PL0133
Viking BD	Viking GD	1975	Gas	12	5.1	PL0092
			Methanol	2	5.1	PL0066
Viking BD	Viking HD	1971	Gas	12	5.6	PL0093
			Methanol	2	5.6	PL0130

The only subsea surface laid structures to be decommissioned in the Viking area under VDP1 are concrete mattresses and grout bags which have been installed to maintain stability of the pipelines along their length and at the ends. Details of the locations of these are presented in the pipeline burial report (Costain, 2014a).

Table 3.10: VDP1 pipeline exposure status

VDP1 Pipelines	Pipeline Status						
	Length of pipeline (m)	Length surveyed (m)	Length of surveyed pipeline exposed/ [spanning] (m)	% of surveyed pipeline exposed/ [spanning]	Maximum height of span (m)	Number of reportable spans	Survey year (year corresponding to maximum length surveyed)
PL0089 & PL0132	3,900	2,954	64 [39]	2.20 [1.30]	0.18	None	2012
PL0090 & PL0131	4,100	2,879	16 [0]	0.60 [0.00]	_	None	2012
PL0091 & PL0133	12,000	11,965	3,893 [11]	32.50 [0.10]	0.22	None	2011
PL0092 & PL0066	5,100	4,023	133 [0]	3.30 [0.00]	_	None	2012
PL0093 & PL0130	5,600	5,600	639 [157]	11.40 [2.80]	0.75	None	2011

Sources: Costain, 2014a; ConocoPhillips, 2012.

ConocoPhillips commissioned a mattress inventory report to identify the number and where possible the burial status of the mattresses in the VDP1 area. Table 3.11 provides an estimate of the dimensions and weights of the mattresses to be decommissioned in the Viking Area under VDP1. Exact measurements are not available and therefore estimates have been made based on the results of pipeline surveys (Costain, 2014b).

Table 3.11: Estimated dimensions and weights of mattresses under VDP1

Dimensions (length x width)*	Number estimated based on observations*	Estimated weight (tonnes)
6 m x 3 m	30	174

Note: *Information from Costain, 2014b.

There are eight, third party crossings which transect the VDP1 pipelines to be decommissioned. Six of these are associated with pipelines and two are associated with the Tampnet telecommunications cable. Table 3.12 outlines the crossings within VDP1.

Table 3.12: Crossings located in the VDP1 Area

VDP1 pipelines crossed	Crossing pipeline description	Pipeline no(s)	Operator
PL0092 & PL0066	Viking BP Platform to LOGGS PR platform 16” gas pipeline and piggybacked 3” methanol pipeline	PL2643 (Gas) PL2644 (Methanol)	ConocoPhillips/ BP
PL0091 & PL0133	Viking BP Platform to LOGGS PR platform 16” gas pipeline and piggybacked 3” methanol pipeline	PL2643 (Gas) PL2644 (Methanol)	ConocoPhillips/ BP
PL0090 & PL0131	Viking BD to CD 12” gas and piggybacked 2” methanol line	PL0089 (Gas) PL0132 (Methanol)	ConocoPhillips/ BP
PL0092 & PL0066	Telecommunications cable	N/A	Tampnet AS
PL0091 & PL0133	Telecommunications cable	N/A	Tampnet AS
PL0089 & PL0132	Vixen VM to Viking BD, 10” gas pipeline and control umbilical	PL1767 (Gas) PL1768 (Umbilical)	ConocoPhillips/ BP
PL0090 & PL0131	Victoria SM to Viking BD platform, 6” flexible gas pipeline and umbilical	PL2526 (Gas) PLU2527 (Umbilical)	Bridge Energy
PL0093 & PL0130	Victoria SM to Viking BD platform, 6” flexible gas pipeline and umbilical	PL2526 (Gas) PLU2527 (Umbilical)	Bridge Energy

Detail for the LDP1 pipelines

Table 3.13 summarises the pipelines to be decommissioned under LDP1. All pipelines are piggybacked and are buried. Surveys conducted between 2009 and 2012 indicated that the burial status of these pipelines is very good, with minimal exposed pipeline and no indication of areas of spanning. Table 3.14 provides 2009 to 2012 survey findings for exposure and spanning of the pipelines.

The only subsea surface laid structures to be decommissioned in the LOGGS area under LDP1 are:

- A single pipeline T-piece (with protective structure) and associated protective mattresses and grout bags located between the Vampire OD, Viscount VO and LOGGS PR.
- Concrete mattresses and grout bags at pipeline ends which will be removed to allow access to make cuts at the satellite end of the pipelines and the remaining mattresses and grout bags which will be decommissioned *in situ.*

Table 3.13: LDP1 pipelines to be decommissioned

From	To	Installed	Type	Diameter (inches)	Length (km)	Pipeline number
Vulcan UR	Vulcan RD	1987	Gas	12	3.7	PL0462
			Methanol	3	3.7	PL0463
Viscount VO	Vampire OD	2002	Gas	12	11.3	PL1962
			Methanol	3	11.3	PL1963
Vampire OD	LOGGS PR	1999	Gas	12	9.0	PL1692
			Methanol	3	9.0	PL1693

Table 3.14: LDP1 pipeline exposure status

LDP1 Pipelines	Pipeline Status						
	Length of pipeline (m)	Length surveyed (m)	Length of surveyed pipeline exposed/ [spanning] (m)	% of surveyed pipeline exposed/ [spanning]	Maximum height of span (m)	Number of reportable spans	Survey year (year correspondin g to maximum length surveyed)
PL0462 & PL0463	3,700	3,700	21.0 [0]	0.6 [0]	_	None	2011
PL1692 & PL1693	9,000	8,694	6.0 [0]	0.1 [0]	_	None	2012
PL1962 & PL1963	11,300	10,277	0.3 [0]	0.0 [0]	_	None	2012

Sources: Costain, 2014a; ConocoPhillips, 2012.

ConocoPhillips commissioned a mattress inventory report to identify the number and where possible the burial status of the mattresses in the LDP1 area. Table 3.15 provides an estimate of the dimensions and weights of the mattresses to be decommissioned under LDP1. Exact measurements are not available and therefore estimates have been made based on the results of pipeline surveys (Costain, 2014b).

Table 3.15: Estimated dimensions and weights of mattresses under LDP1

Dimensions (length x width)*	Number estimated based on observations*	Estimated weight (tonnes)
6 m x 3 m	97	644.65

Note: *Information from Costain, 2014b.

There are five, third party crossings associated with the LDP1 pipelines to be decommissioned. Table 3.16 outlines the crossings within LDP1.

Table 3.16: Crossings located in the LDP1 area

LDP1 pipelines crossed	Crossing pipeline description	Pipeline number	Operator
PL1962 & PL1963	Ann XM to LOGGS PR 12" gas pipeline	PL947	Centrica
PL1692 & PL1693	Audrey WD to LOGGS PP 20" gas and piggybacked 3" methanol pipelines	PL496 (Gas) PL497 (Methanol)	Centrica
	Saturn ND to LOGGS PR 14" gas and piggybacked 3" methanol – There are two separate crossings by these pipelines	PL2107 (Gas) PL2108 (Methanol)	ConocoPhillips/ BP
	LOGGS PP to TGT 36" gas pipeline	PL0454	ConocoPhillips/ BP

Figure 3.8 illustrates the LDP1 T-piece and protective structure, which is comprised of steel, has a combined weight of 35 tonnes and dimensions of approximately 11 m in length and 10 m in width. The dimensions and weights of the grout bags protecting the T-piece are currently unknown.

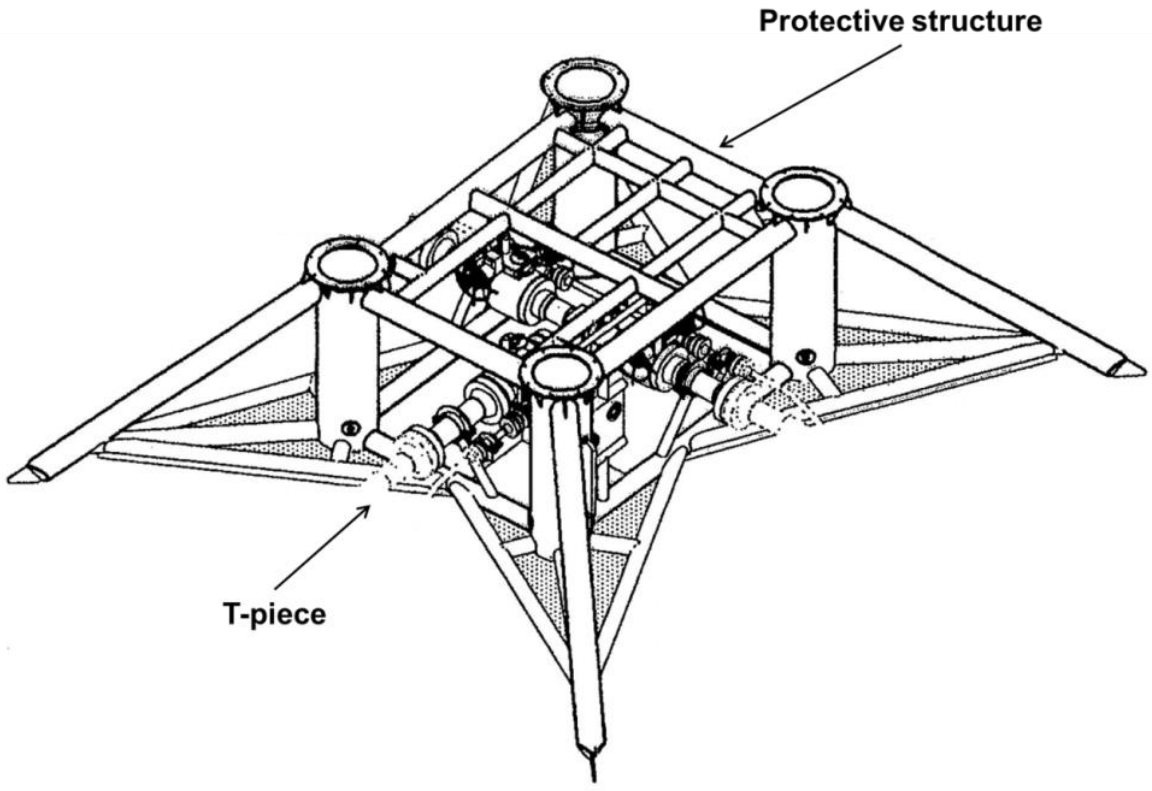


Figure 3.8: Illustration of the LDP1 T-piece and protective structure to be decommissioned

3.4.5 Wells

A total of 29 platform wells and conductors are to be decommissioned under VDP1 and LDP1. The P&A of these wells and the conductors are detailed in two separate environmental direction documents submitted to DECC.

These documents present the key technical and environmental information and the implications of the P&A programme for the purpose of seeking dispensation from

submitting an ES under Regulation 6(2) of the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended).

Under the Offshore Chemicals Regulations (as amended) additional location-specific risk assessments of chemical use and discharge will be conducted. A licence under MCCA will be applied for to cover the removal of the conductors across all the wells.

The decommissioning of the wells and conductors under VDP1 and LDP1 and the associated impacts are therefore not included within this ES.

VDP1 wells to be plugged and abandoned

At the start of the well P&A campaign, a total of 15 gas/ condensate platform wells are to be plugged and abandoned under VDP1. These wells are outlined in Table 3.17.

Table 3.17: Wells included under VDP1

Well	Drilled	Current status*	Latitude; Longitude	Easting; Northing
GB_049_17_G01	1976	Suspended	53° 26’ 53.92” N; 02° 15’ 22.39” E	450 603.6 E; 5 922 400.9 N
GB_049_17_G04	1982	Shut-in	53° 26’ 53.90” N; 02° 15’ 22.39” E	450 601.7 E; 5 922 400.6 N
GB_049_17_G05	1986	Shut-in	53° 26’ 53.82” N; 02° 15’ 22.42” E	450 604.1 E; 5 922 397.8 N
GB_049_17_05Z	1969	Suspended	53° 29’ 50.72” N; 02° 19’ 32.95” E	455 277.5 E; 5 927 818.5 N
GB_049_17_H02	1974	Shut-in	53° 29’ 50.64” N; 02° 19’ 32.90” E	455 276.6 E; 5 927 816 N
GB_049_17_H03	1979	Shut-in	53° 29’ 50.74” N; 02° 19’ 32.86” E	455 275.8 E; 5 927 819.1 N
GB_049_17_D01	1974	Shut-in	53° 26’ 30.73” N; 02° 23’ 42.69” E	459 826.9 E; 5 921 597 N
GB_049_17_D02	1968	Shut-in	53° 26’ 30.81” N; 02° 23’ 42.69” E	459 826.9 E; 5 921 599.5 N
GB_049_17_C01	1974	Shut-in	53° 25’ 26.45” N; 02° 22’ 36.25” E	458 583.5 E; 5 919 621.2 N
GB_049_17_C02Z	1974	Shut-in	53° 25’ 26.53” N; 02° 22’ 36.35” E	458 582.6 E; 5 919 619 N
GB_049_17_C03	1982	Suspended	53° 25’ 26.35” N; 02° 22’ 36.28” E	458 584.2 E; 5 919 618.4 N
GB_049_17_C04	1984	Shut-in	53° 25’ 26.43” N; 02° 22’ 36.34” E	458 585.3 E; 5 919 620.5 N
GB_049_16_E03A	1975/ 1979	Shut-in	53° 26 02.12” N; 02° 09’ 16.42” E	443 833.3 E; 5 920 875.4 N
GB_049_16_E04	1982	Shut-in	53° 26 02.03” N; 02° 09’ 16.35” E	443 832 E; 5 920 872.6 N
GB_049_16_E05	1983	Shut-in	53° 26 02.03” N; 02° 09’ 16.35” E	443 831.7 E; 5 920 875.1 N

Note: * Well status prior to the commencement of the well P&A campaign.

LDP1 wells to be plugged and abandoned

At the start of the well P&A campaign, a total of 14 gas/ condensate platform wells are to be plugged and abandoned under LDP1 (Table 3.18). Three additional wells included under the LDP1 infrastructure were abandoned previously (shaded grey) and are not included in the LDP1 activities.

Table 3.18: Wells included under LDP1

Well	Drilled	Current status*	Latitude; Longitude	Easting; Northing
GB_048_25b_U01	1988	Shut-in	53° 15’ 27.13” N; 01° 58’ 37.74” E	431 399.1 E; 5 901 477.3 N
GB_048_25b_U02	1988	Shut-in	53° 15’ 29.11” N; 01° 58’ 18.02” E	431 401.8 E; 5 901 474.4 N
GB_048_25b_U03	1988	Shut-in	53° 15’ 29.28” N; 01° 58’ 17.85” E	431 398.7 E; 5 901 479.7 N
GB_048_25b_U04	1988	Shut-in	53° 15’ 29.06” N; 01° 58’ 17.99” E	431 399.7 E; 5 901 472.3 N
GB_048_25b_U06	1989	Shut-in	53° 15’ 29.06” N; 01° 58’ 18.00” E	431 399.4 E; 5 901 474.8 N
GB_048_25b_U07	1989	Shut-in	53° 15’ 29.06” N; 01° 58’ 18.00” E	431 401.5 E; 5 901 476.9 N
GB_048_25b_U08	1991	Shut in	53° 15’ 29.06” N; 01° 58’ 18.00” E	431 397.2 E; 5 901 472.6 N
GB_048_25b_U09	1992	Shut-in	53° 15’ 29.15” N; 01° 58’ 17.618” E	431 394.4 E; 5 901 475.8N
GB_049_16_W01Z	2002	Producing	53° 23’ 12.66” N; 02° 08’ 59.618” E	443 461 E; 5 915 649 N
GB_049_16_W02	2002	Previously abandoned	53° 23’ 12.944” N; 02° 08’ 59.655” E	443 461.8 E; 5 915 651.1 N
GB_049_16_W02Z	2002	Producing	53° 23’ 12.944” N; 02° 08’ 59.655” E	443 461.8 E; 5 915 651.1 N
GB_049_16_W03	2002	Suspended	53° 22’ 48” N; 02° 07’ 48” E	443 458.7 E; 5 915 647.8 N
GB_049_16_11	1993	Shut-in	53° 27’ 56.976” N; 02° 02’ 32.858” E	436 434.3 E; 5 924 549.8 N
GB_049_16_V02	1999	Shut-in	53° 27’ 02” N; 02° 02’ 55” E	436 438.5 E; 5 924 522.6 N
GB_049_16_V03	2004	Previously abandoned	53° 27’ 56.894” N; 02° 02’ 33.106” E	436 438.4 E; 5 924 516 N
GB_049_16_V03Y	2004	Producing	53° 27’ 56.894” N; 02° 02’ 33.106” E	436 438.4 E; 5 924 516 N
GB_049_16_V03Z	2004	Previously abandoned	53° 27’ 56.894” N; 02° 02’ 33.106” E	436 438.4 E; 5 924 516 N

Note: * Well status prior to the commencement of the well P&A campaign.

Drill cuttings

Survey work carried out by Fugro (2014a; 2014b; 2014c and 2014d) found no evidence of cuttings piles on the seabed in the vicinity of the surveyed wellheads. It is assumed that the dynamic marine environment present at the surveyed structures has resulted in the redistribution of any drill cuttings from around all of the wellheads in the VDP1 and LDP1 areas. Drill cuttings are therefore not required to be scrutinised under the OSPAR Recommendation 2006/5 *Management Regime for Offshore Cuttings Piles* and are excluded from further discussion.

Proposed Schedule for VDP1 and LDP1

The VDP1 and LDP1 facilities are being decommissioned between 2014 and 2020. The current, proposed schedules for the VDP1 and LDP1 decommissioning activities are presented in Figures 3.9 and 3.10. The exact timing of events will be decided once contracts have been awarded and may be subject to change depending on the availability of vessels and the possible benefits of co-operation with other offshore activities. ConocoPhillips will inform DECC of all such proposed changes.

3.5 Inventory of Materials

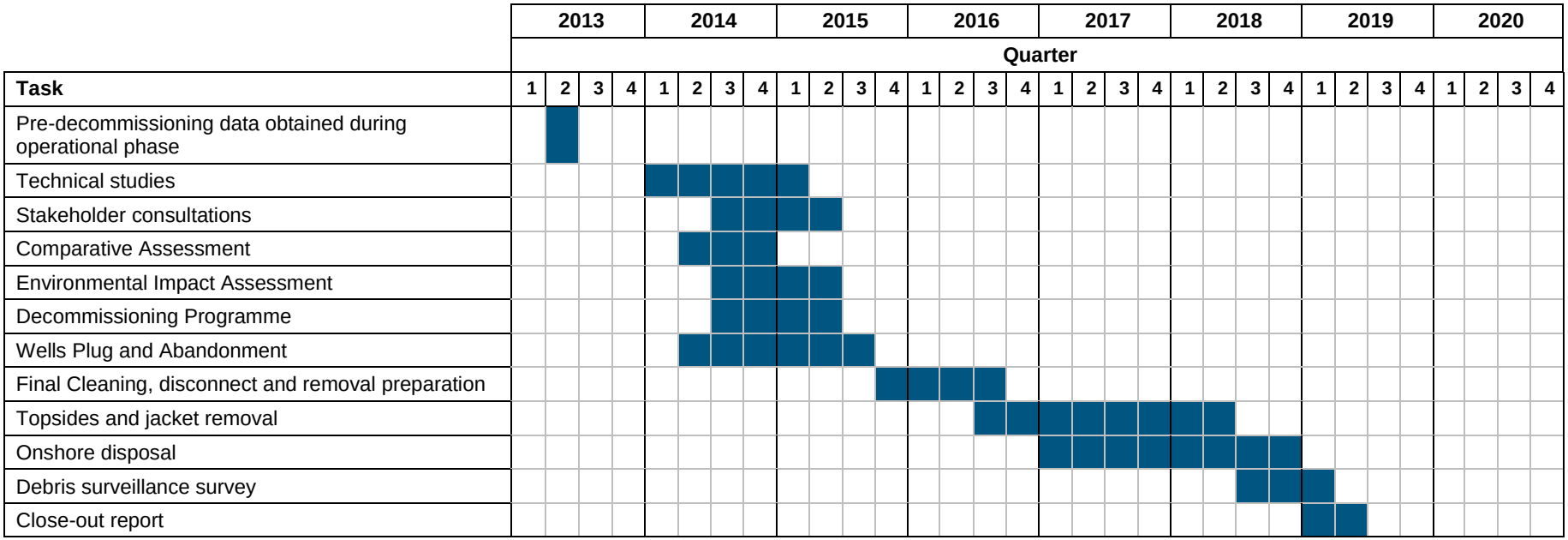
This section presents an estimate of the mass of different types of material in the various facilities to be decommissioned under VDP1 and LDP1. Based on evidence gathered from surveys and cleaning/ disposal certificates at the TGT and from topside pipework removed during the early well P&A work, it is assumed that Naturally Occurring Radioactive Material (NORM) scale deposits will be present on the interior surface of all the pipework to be decommissioned. As a result, all pieces of infrastructure removed which were exposed to production fluids (pipelines, pipework, vessels, risers, etc.,) will be monitored for potential NORM contamination. However the quantities of NORM within this material are not known and are difficult to estimate, as deposition is not likely to be uniform. Detail regarding weights of NORM found will be documented following treatment.

3.5.1 VDP1 facilities

Table 3.19 presents an estimate of the mass of different types of material in the various facilities to be decommissioned under VDP1.

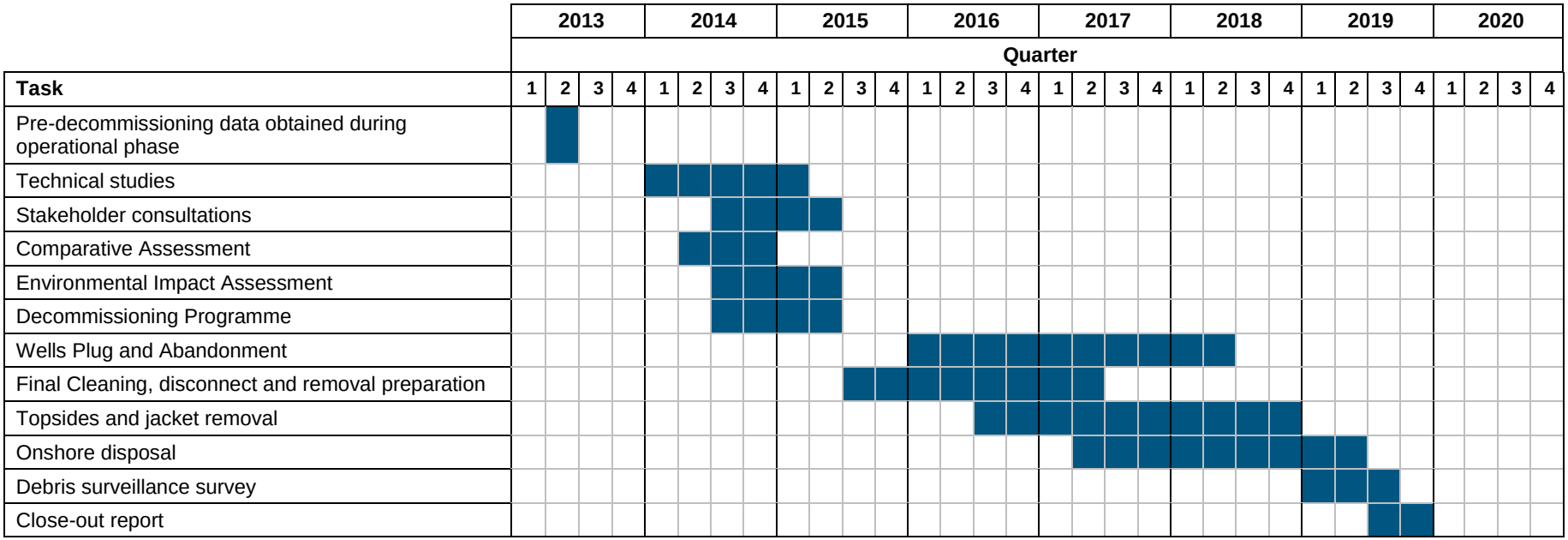
3.5.2 LDP1 facilities

Table 3.20 presents an estimate of the mass of different types of material in the various facilities to be decommissioned under LDP1.



*Indicative schedule. The availability of key vessels will drive the dates of the operations.

Figure 3.9: Current VDP1 decommissioning schedule



*Indicative schedule. The availability of key vessels will drive the dates of the operations.

Figure 3.10: Current LDP1 decommissioning schedule

Table 3.19: Inventory of the main materials to be decommissioned under VDP1

Facility	Mass (tonnes)											
	Steel*	Concrete	Plastic	Coal tar	Wood	Rockwool	PFP**	Copper	Lead	Aluminium	Miscellaneous ***	Total
VDP1 Platforms (topsides and jackets)												
Viking CD	1,333.6	0.0	1.0	0.0	1.6	0.0	0.0	3.0	2.6	0.0	15.7	**1,357.5**
Viking DD	904.6	0.0	1.0	0.0	0.0	0.0	0.0	3.0	2.6	0.0	15.7	**926.9**
Viking ED	1,034.5	0.0	2.5	0.0	0.0	0.0	1.0	7.5	0.0	0.0	115.9	**1,161.4**
Viking GD	727.3	0.0	1.0	0.0	0.0	0.0	0.0	3.0	2.6	0.0	14.9	**748.8**
Viking HD	885.3	0.0	1.0	0.0	0.0	0.0	0.0	3.0	2.6	0.0	15.2	**907.1**
Platforms Total	***4,885.3***	***0.0***	***6.5***	***0.0***	***1.6***	***0.0***	***1.0***	***19.5***	***10.4***	***0.0***	***177.4***	***5,101.7***
VDP1 Pipelines												
PL0093	610.1	362.3	0.0	55.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**1,027.7**
PL0130	41.9	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**43.6**
PL0090	446.7	266.0	0.0	40.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**753.2**
PL0131	30.6	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**31.9**
PL0089	425.0	253.0	0.0	38.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**716.5**
PL0132	29.1	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**30.3**
PL0091	1,307.4	778.4	0.0	118.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**2,204.4**
PL0133	89.7	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**93.4**
PL0092	555.6	329.9	0.0	50.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**935.9**
PL0066	38.1	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**39.7**
Pipelines Total	***3,574.2***	***1,989.6***	***9.5***	***303.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***5,876.6***

Notes: *Steel comprises all steel and stainless steel.
** Passive Fire Protection.
***Miscellaneous contains a list of mixed items such as electrical/ electronic items and fittings, paints, safety equipment and some plant equipment not defined under the other sub-headings

Source: ConocoPhillips, 2014a

Table 3.20: Inventory of the main materials to be decommissioned under LDP1

Facility	Mass (tonnes)											
	Steel*	Concrete	Plastic	Coal tar	Wood	Rockwool	PFP**	Copper	Lead	Aluminium	Miscellaneous ***	Total
LDP1 Platforms (topsides and jackets)												
Viscount VO	1,017.10	0.00	0.90	0.00	0.00	0.00	0.00	2.30	4.70	0.02	36.20	**1,061.20**
Vampire OD	885.70	0.00	1.00	0.00	0.00	0.00	0.00	2.40	4.00	0.02	39.10	**932.20**
Vulcan UR	1916.20	0.00	4.10	0.00	0.00	1.50	5.50	12.40	7.20	0.00	106.90	**2,053.80**
Platforms Total	***3,819.00***	***0.00***	***6.00***	***0.00***	***0.00***	***1.50***	***5.50***	***17.10***	***15.90***	***0.04***	***182.20***	***4,047.20***
LDP1 Pipelines												
PL0462	488.70	368.90	0.00	31.60	0.00	0.00	0.00	0.00	0.000	0.00	0.00	**889.20**
PL0463	102.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**102.20**
PL1962	1,491.10	0.00	25.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1516.30**
PL1963	240.70	0.00	6.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**247.10**
PL1692	1,190.10	0.00	20.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**1210.20**
PL1693	191.70	0.00	5.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**196.80**
Pipelines Total	***3,704.50***	***368.90***	***56.80***	***31.60***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***	***5,444.50***

Notes: *Steel comprises all steel and stainless steel.
** Passive Fire Protection.
***Miscellaneous contains a list of mixed items such as electrical/ electronic items and fittings, paints, safety equipment and some plant equipment not defined under the other sub-headings

Source: ConocoPhillips, 2014a.

3.6 Overview of the Options Available for VDP1 and LDP1 Activities

This section describes the options that ConocoPhillips considered for the VDP1 and LDP1 decommissioning activities. Table 3.21 provides a summary of the VDP1 and LDP1 decommissioning options. For the purpose of this assessment for the removal of the jacket and topside there is the worst case assumption that there will be one lift for the topside and one lift for the jacket. However depending on the removal contractor selected, there is the option for both the jacket and topside to be removed together in a single lift operation.

Table 3.21: Decommissioning options considered for VDP1 and LDP1

VDP1/ LDP1 Facility	Decommissioning Option	Method
Topsides	Full removal	1. Reverse installation (multiple lifts)
		2. Piece-small offshore deconstruction
		3. Single lift
Jacket (and risers)	Full removal	1. Single lift
		2. Cut and lift
		3. Flotation
Pipelines	Full removal	1. Reverse S-Lay/ Reverse Reel
		2. Cut and lift
	Partial removal	Cut and lift
	Decommission *in situ*	1. Minor intervention
		2. Minimal intervention
Mattresses	Full removal	
	Burial	
	Minimal disposal option (decommission *in situ*)	
T-piece (LDP1 only)	Full removal	Cut and lift via a Dive Support Vessel (DSV), with a supply vessel on site
Wells (and conductors)	P&A	1. Cut and pull tubing
		2. Through tubing

3.6.1 Topside removal options

ConocoPhillips plan to fully remove the topsides of all eight platforms under VDP1 and LDP1. The planned high-level process for the removal of each of the eight topsides is:

- Completion of the platform removal preparations, and
- HLV removal of each of the platform topsides.

The topsides will be removed and returned to shore for recycling and disposal. The three removal options considered for decommissioning the eight topsides were the following.

1. Reverse installation (multiple lifts)

For reverse installation, the topsides modules would be separated by deconstruction of the module interfaces and then removed individually by a dedicated crane vessel. The modules would be back-loaded to the deck of the crane vessel or to a cargo barge, and then transported in batches to an onshore disposal yard. They would be offloaded either directly from the vessel to the quayside or via a cargo barge towed to the quayside. The modules may then be assigned for re-use or broken down for recycling or disposal.

2. Piece-small offshore deconstruction

In the piece-small option, the topsides modules and other facilities would be dismantled offshore using mechanical excavators equipped with cutting tools. Manual hot and cold cutting techniques would be used to breakdown the facilities into small manageable sections, which would then be sorted and loaded into containers for transportation to shore on supply vessels. The work would be supported by the accommodation work vessel stationed at the unmanned satellite platforms. There would be two main phases to this option.

- ***Stage 1.*** All cables and hazardous waste would be removed from the topsides' modules in turn. Module internals (vessels, pipes and secondary structures) would then be removed. The remaining module structures would then be cut into container sized sections. The accommodation, life support and utility systems would also be removed piece small.
- ***Stage 2.*** After removal of all the modules and facilities, the module support frame would be removed by reverse installation, using a HLV.

Once materials had been sorted into the relevant groups, it would be loaded into separate containers and shipped to an onshore disposal site.

3. Single lift

In the single lift option, a HLV capable of lifting the entire topsides in one lift would be utilised. The topsides would be prepared for this by a combination of engineering down and cleaning; module sea-fastening; and structural strengthening. The topsides would then be transported to the designated disposal yard by HLV or cargo barge where they would be transferred to the quayside for dismantling.

3.6.2 Jacket removal options

As the weights (in air) of the jackets (Table 3.5) are <10,000 tonnes, they fall within the OSPAR 98/3 category of steel structures for which derogation cannot be sought. Therefore the only option available for the platforms is complete removal. The planned high level process for the removal of each of the eight jackets is:

- Completion of the platform removal preparations;
- Cutting of the risers;
- Cutting of the jacket piles to a suitable depth below the natural seabed level (depth to be determined based on prevailing hydrodynamic conditions), currently estimated at 3.0 m;
- HLV removal of each platform jacket (including risers); and
- Removal of additional subsea infrastructure if required.

The preferred methodology of ConocoPhillips for cutting the piles is to use internal cuts which will not require external dredging of the jacket legs. The exception to this will be the Vulcan UR jacket where it is known that internal leg cutting is not possible and will require excavation at the base of each leg/ pile structure to gain access to make an external cut. External cutting will only be undertaken on the remaining jackets in the event of debris prohibiting access within the jacket legs.

The three removal options considered by ConocoPhillips for the complete removal of the eight jackets are described below.

1. Single lift

In the single lift option, a HLV capable of lifting the entire jacket in one lift would be utilised. The jacket would be prepared for lifting by a combination of engineering down and cleaning; sea fastening and structural strengthening. The jacket would then be transported by the HLV or cargo barge to the quayside.

2. Cutting and lifting

In the cutting and lifting option, the jacket members would be cut into sections using a combination of diamond-wire cutting, abrasive water jetting and hydraulic shear. Each jacket section would be held in place on the end of a lifting strop from a crane during cutting operations, and, after separation from the remainder of the jacket, would be lifted by an HLV. Once the jacket sections have been separated and lifted to the surface, they would be sea-fastened and transported to an onshore disposal yard, either on dedicated transportation barges or on the HLV.

The upper section of the jacket, above the jacket footings, would be removed in several sections. The jacket footings would then be cut into sections and removed down to the seabed. The piles in the seabed would be cut at a suitable depth below the natural seabed so that the seabed is left clear of obstructions. Depending on hydrodynamic conditions at each site this may be to a depth of 3.0 m (DECC, 2011a; ConocoPhillips, 2013).

3. Flotation

In the flotation option, the jackets would be completely removed using buoyancy tank assemblies (BTAs). Initial preparatory work would involve cutting the majority of the structural members at the section of jacket to be separated, leaving enough in place to secure the jacket during installation of the BTAs. Support brackets would be fitted to each of the corner legs to secure the BTA units. Once the BTAs have been installed, the BTAs would be deballasted. Two tugs would keep the jacket on station while the remaining piles were cut, allowing the jacket to float free. It would then be towed to an inshore location close to the onshore yard for dismantling. On arrival at the inshore grounding location, the BTAs would be ballasted until the jacket rested on the seabed. The BTAs would then be removed, the inshore spread mobilised and the jacket cut into manageable sections. These would be transported to the demolition quay for further dismantling and then recycling.

3.6.3 Pipeline decommissioning options

Pipeline decommissioning is governed by the Petroleum Act 1998 and the requirements are set out within the DECC Guidance Notes. The Guidance Notes state that there are no prescribed options for pipeline decommissioning; all feasible options must be considered and a CA undertaken to determine which decommissioning option provides the most acceptable outcome on the basis of the criteria outlined in the guidance.

The options considered by ConocoPhillips for the decommissioning of the VDP1 and LDP1 infield pipelines were the following:

- **Reverse Reel:** Pipelines would be exposed (if required) using jetting methods and would be removed by reverse reel prior to transport to shore. This method would be used for pipelines composed of flexible plastic and could be used for the full or partial removal of longer lengths of pipeline. This method would not be suitable for the removal of concrete coated pipelines.

- **Reverse S-Lay:** Lengths of buried pipeline would be exposed where required using jetting methods and would be removed by reverse S-Lay and would be cut on board the vessel prior to transportation to shore. This method could be used for pipelines with a concrete coating and may be suitable for the full or partial removal of pipelines.

- **Cut and Lift:** Pipelines would be exposed using jetting methods (where required) and would be removed by cutting with an underwater pipe cutter and lifting the cut pipeline sections onto a vessel for transportation to shore. This method may be suitable for the full or partial removal of short sections of plastic and concrete coated pipelines.

- **Cut, Float and Tow:** Long lengths (up to 4.5 km) of pipeline would be exposed at the seabed and cut if necessary. Lifting handles would be attached to the pipeline by divers and the pipeline would be raised to the surface by crane, at which point buoyancy devices would be inserted under the pipeline to keep it afloat. The pipeline would then be towed to a suitable dismantling yard onshore. This method may be suitable for the full removal of pipelines.

- **Decommission *in situ*:** The following options have been adapted from the Oil and Gas UK document *Decommissioning of Pipelines in the North Sea Region 2013* (OGUK, 2013).

    - **Minor intervention:** Pipelines decommissioned *in situ* would be left in such a manner that they do not pose a risk to other users of the sea, including fisheries. This would involve reburial or rock-placement on exposed or at risk sections or pipeline ends. Reasonable attempts will be made to remove all visible mattresses where safe to do so.

    - **Minimum intervention:** Pipeline will be cut at the satellite platform end; the exposed ends would be buried either with rock-placement or retrenching to make them safe to fisheries. This option would not include burial of exposed or spanning sections. Mattresses would be decommissioned *in situ*.

The first four above options include reasonable attempts to remove mattresses, where safe to do so. However, with decommissioning *in situ,* mattresses will be left in-place where possible. When gaining access to the pipeline ends to sever the connection with the satellite platform, there is potential for the need to remove a small number of mattresses under the minimum intervention option. However this will only be determined upon inspection at the time of decommissioning.

Table 3.22 provides as summary of the infield pipeline options that were considered during the CA following evaluation of the technical feasibility of the initial set of options. In all options, the crossings would be decommissioned *in situ.* Under the full and partial removal options, the pipeline will be cut at a safe distance from the crossing and the cut ends either covered with rock-placement or re-trenched as required.

Table 3.22: Decommissioning options considered in the CA for the VDP1 and LDP1 infield pipelines

Decommissioning options	Method	Description
Full Removal	Reverse S-Lay/ Reverse Reel	Pipelines would be exposed (if required) using jetting methods and would be removed by reverse S-lay (pipelines with concrete coating) or reverse reel (pipelines composed of flexible plastic coating) prior to transport to shore. Reasonable attempts would be made to remove all mattresses where safe to do so.
	Cut and Lift	Pipelines would be exposed using jetting methods (where required) and would be removed by cutting with an underwater pipe cutter. Cut pipeline sections would then be lifted onto a vessel for transportation to shore. Reasonable attempts to remove all mattresses where safe to do so.
Partial Removal	Cut and Lift	Only exposed/ spanned sections of pipeline would be removed. Cut ends of pipelines would be covered by rock-placement. Reasonable attempts would be made to remove all mattresses where safe to do so. Any remaining pipeline would be left open and flooded with seawater.
Decommission *in situ*	Minor Intervention	Pipelines decommissioned *in situ* would be left in such a manner that they do not pose a risk to other users of the sea, such as fisheries. This would involve rock-placement or trenching of the exposed/ spanned sections. Cut pipeline ends would be covered with rock-placement where required. Reasonable attempts would be made to remove all mattresses where safe to do so. Pipelines would be left open and flooded with seawater.
	Minimal Intervention	Rock-placement on the cut pipeline ends only, to make them safe to fisheries. The remaining pipeline would be left in its current state, marked on sea charts and notifications issued to fisheries/ other users of the sea. All mattresses would be decommissioned *in situ** in their current state to maintain pipeline stabilisation, minimise disturbance of the established environment and reduce the requirements for the introduction of new material to the SCI. Pipelines would be left open and flooded with seawater.

Note:* In order to gain access to cut the pipeline at each of the satellite platforms, there may be a need to remove a small number of mattresses.

3.6.4 T-piece removal options

ConocoPhillips plan to fully remove the T-piece and the protective structure from the seabed. Mattresses and grout bags moved to gain access to the T-Piece and protective structure will be removed for onshore disposal. One method of removal has been considered by ConocoPhillips. The T-piece will be removed by cutting it from the attached pipelines with an underwater cutter, the securing pin piles will be excavated to a suitable depth based on the hydrodynamic conditions present (approximately 3 m) and these will then be cut (DECC, 2011a; ConocoPhillips, 2013). The T-piece, protective structure and associated mattresses and grout bags which are to be removed, will then be lifted from the seabed onto a DSV and returned to shore for recycling and disposal.

3.6.5 Mattress removal options

VDP1 and LDP1 include the decommissioning of mattresses placed on the seabed for protection or stabilisation purposes. Three options were considered by ConocoPhillips for the decommissioning of the mattresses associated with the pipelines:

- **Full removal –** the mattresses would be completely removed from the seabed onto a vessel for transportation to shore.

- **Burial –** the mattresses may be trenched to a pre-determined depth and back-filled.
- **Minimal disposal option (decommission *in situ)* –** mattresses would be decommissioned *in situ* in their current state to maintain pipeline stability, minimise seabed disturbance and reduce the requirements for the introduction of new material to the seabed. There may still be a requirement to remove some mattresses under minimal disposal where these need to be moved to gain access to make cuts to the pipelines being decommissioned.

3.6.6 Well P&A

The VDP1 and LDP1 involve the permanent abandonment of the designated wells.

The well abandonment operations began in June 2014 using the *Ensco 92* jack-up rig. Fifteen platform wells are included within VDP1. The 15 wells will be P&A by the *Ensco 92* jack-up drilling rig in an estimated 540 day programme of work.

Fourteen platform wells are included within LDP1. Following the P&A of the VDP1 wells, the 14 LDP1 wells will be P&A by the *Ensco 92* in an estimated 550 day programme of work. This work is scheduled to commence on 6 December 2015.

All hazardous zones (hydrocarbon bearing, over-pressured and/ or porous, and permeable) have and will be adequately isolated from the surface and where necessary from each other. The wellheads will also be removed following well P&A.

There are two abandonment options for the P&A of the wells, depending on the well conditions:

- **Cut & Pull Tubing** – the production tubing and/ or casings strings are removed from the well before the cement barriers can be put in place.
- **Through Tubing** – the production tubing and casing strings remain in the well and cement is circulated through the tubing, isolating hazardous zones.

ConocoPhillips have been collaborating with industry including counterparts in Norway/ Houston, partners, and the Oil and Gas UK Well Life Cycle Practices Forum, to ensure knowledge sharing and best practice with respect to well abandonments. The removal of the production tubing is considered by ConocoPhillips to be the Best Practicable Environmental Option, in order to establish the quality and quantity of the cement behind the casing. A new technology study is also being carried out by consultants to identify new abandonment technologies and techniques.

The abandonment of the wells will be carried out in accordance with the ConocoPhillips SNS Abandonment approach which complies with the intent of following UK legislation, industry guidelines and internal ConocoPhillips standards listed below:

- Offshore Installations and Wells (Design and Construction) Regulations 1996.
- Offshore Installations (Safety Case) Regulations 2005 (SI 2005/ 3117).
- Oil and Gas UK Guidelines for Suspension and Abandonment of Wells, Issue 4, July 2012.
- ConocoPhillips UK-00529 UK Wells Technical Standards Manual.
- ConocoPhillips UK-00586 UK Well Examination Scheme.

The P&A of these wells and the associated impacts are detailed within two separate environmental direction documents submitted to DECC.

3.7 Overview of the VDP1 and LDP1 CA Process

ConocoPhillips carried out a CA of the decommissioning options, as required by the Petroleum Act 1998, for the pipelines to determine which option was most suitable in view of the status, condition and environmental setting of those facilities (BMT Cordah, 2014a).

The individual decommissioning options for the pipelines were assessed against the five criteria provided in DECC's Guidance Notes (DECC, 2011a) and are presented in Figure 3.11.

Technical Feasibility A qualitative assessment of Technical Feasibility and Recoverability from Major Project Failure.
Safety A quantitative assessment of Potential Loss of Life of personnel working on the decommissioning options using the method given in Safetec (2005).
Environmental Impact (a) Qualitative assessment of Environmental Risks onshore and offshore using a ConocoPhillips risk assessment matrix; and (b) Quantitative estimation of Energy Usage and CO_2 Emissions using the method given in IoP (2000).
Societal Impact A qualitative assessment of Societal Risks to other users of the sea and to those onshore. This is assessed using a ConocoPhillips risk assessment matrix.
Cost A quantitative comparison of the estimated Cost for each option.

Source: BMT Cordah, 2014a

Figure 3.11: Five assessment criteria from the DECC Guidance Notes

The scores from each of the assessments were expressed in their respective quantitative and qualitative units. Justification for the scores assigned during the assessments, as well as assumptions and limitations were noted.

To enable a comparison of the options to be made, the results were then collated and compared using a normalised/ weighted scoring system, where the results of each of the assessments were expressed in common units and ranked in order of performance from best to worst, based on the percentage weighting assigned by ConocoPhillips (Table 3.23).

Table 3.23: Weightings of options

Criteria/ sub-criteria	Weighting (percentage)
Technical Feasibility	15
Safety	30
Environmental/ Environmental Risk	15
Environmental/ Energy Usage	5
Environmental/ Emissions	5
Societal/ Socioeconomic Risk	10
Cost	20
Total	**100**

Source: BMT Cordah, 2014a

The maximum percentage weighting value for each criterion was assigned to the best performing (and therefore most preferable) option. All subsequent options were assigned a normalised weighting in proportion to the best performing option. The output was a matrix presenting normalised/ weighted scores for the criteria/ sub-criteria for every option.

An overall score was established by totalling the normalised/ weighted scores of the assessments and comparing the totals. The output from the CA was used to select the ConocoPhillips preferred decommissioning option. A CA report documented the justification for the selection (BMT Cordah, 2014a).

The Guidance Notes (DECC, 2011a) make provision for weightings to be assigned to the scoring for the individual assessments to transparently reflect the proportionality/ or balancing of the options from the viewpoint of the operator or its stakeholders. The outcome of the CA process for decommissioning the pipelines is summarised in Section 3.10 below. The outcomes for decommissioning the remaining VDP1 and LDP1 facilities (platforms, wells and subsea infrastructure) are also summarised in Section 3.10.

3.8 Preparatory Work for Decommissioning the VDP1 and LDP1 Facilities

The initial decommissioning operations will be undertaken using a combination of the *Ensco 92* drilling rig and a bridge linked, jack-up Accommodation Work Vessel (AWV) stationed at the unmanned satellite platforms in the SNS, with an option to utilise a helicopter flying campaign from one of the main offshore complexes to the satellite platforms. The two vessels will attend each satellite installation on separate occasions and will not be present at the same target location.

ConocoPhillips are undertaking site specific assessments (SSAs) to determine the requirement for the placement of rock on the seabed at the AWV locations, to protect against possible:

- Punch-through. Whereby the AWV spud-cans suddenly penetrate through the seabed resulting in the uneven distribution of the vessels weight and ultimate destabilisation and or listing of the vessel.
- Hang-up. Whereby the vessels spud-cans penetrate through the seabed to a depth which prevents the uniform removal of the four legs, resulting in the potential for the destabilisation of the vessel or the lowering of the vessel within the water below safe depths and possible capsize.
- Seabed scour at the AWV spud cans.

The SSAs are ongoing (Table 3.24) with three locations yet to fully completed. However; initial assessments have indicated rock-placement (rock berms) are required at four of the eight VDP1 and LDP1 platform locations.

Where the SSAs are yet to be finalised, the worst case rock-placement quantity of 34,000 tonnes has been assumed (based on the result of the Viking HD SSA), albeit the actual results of the SSAs for Viking CD, Viscount VO and Vampire/ Valkyrie OD are anticipated to indicate that smaller rock quantities will be required at these three locations.

Rock-placement will not be required at the Vulcan UR location (Table 3.24), however, a contingency placement of 1,000 tonnes to remediate against scour whilst on location has been included.

Table 3.24: Status of Site Specific Assessments

Area/ DP	Platform	SSA status	Rock required	Rock berm height (m)	Quantity of rock required (Te)	Area of Impact (km^2)
LOGGS/ LDP1	Vulcan UR	Complete	Yes	Not applicable	1,000 (Note 1)	0.00110
	Viscount VO	Not commenced	Note 2	4.0	34,000	0.00788
	Vampire/ Valkyrie OD	Not commenced	Note 2	4.0	34,000	0.00788
Viking/ VDP1	Viking CD	In progress	Note 2	4.0	34,000	0.00788
	Viking DD	Complete	Yes	3.0	22,500	0.00627
	Viking ED	Complete	Yes	3.0	20,000	0.00611
	Viking GD	Complete	Yes	3.5	25,000	0.00656
	Viking HD	Complete	Yes	4.0	34,000	0.00788

Note 1: contingency only
Note 2: Where the SSAs are yet to be finalised, the worst case rock-placement quantity of 34,000 tonnes and berm height of 4.0 m (based on the result of the Viking HD SSA) has been assumed.

Historic rock-placement applications made by ConocoPhillips and other operators are presented in Table 3.25.

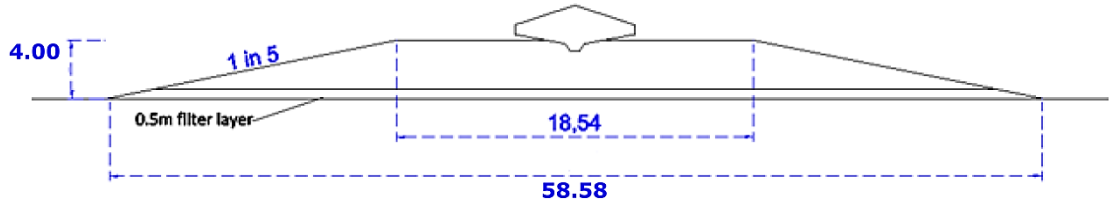
Table 3.25: Historic rock-placement at platforms in the southern North Sea

Platform/ block visited	Operator	Date on location	Deposition details
Vanguard QD	ConocoPhillips	February to June 2013	Seabed stabilisation required for soils support and safety of personnel and vessel. 8,000 tonnes of rock/ gravel. Rock/ gravel ranged from 5 to 20 cm.
South Valiant TD		April to August 2014	Seabed stabilisation required for soils support and safety of personnel and vessel. 30,000 tonnes of rock/ gravel. Rock/ gravel ranged from 11 to 22 mm.
North Valiant 1 PD platforms		December 2014 to present	A Direction under the EIA Regulations was given to allow the deposition of 11,000 tonnes of rock/ gravel for seabed stabilisation to prevent scour. 4,100 tonnes of rock/ gravel. Rock/ gravel ranged from 11 to 22 mm. 6,850 tonnes of rock/ gravel. Rock/ gravel ranged from 22 to 95 mm.
Block 49/27a	Perenco UK Limited	March 2014	3,000 tonnes of rock material.
Block 48/8	Shell UK Limited	April 2014	2,200 tonnes of rock material.
Block 48/19	Shell UK Exploration and Production Limited	May 2015	No details available.
Block 49/26	Perenco (Gas) Limited	July 2014	No details available.
Block 49/27	Perenco UK Limited	October 2014	1,350 tonnes of rock material.
Block 48/7b	Perenco UK Limited	November 2014	3,500 tonnes of rock material.
Block 48/14	Shell UK Limited	November 2014	400 tonnes of gravel.

ConocoPhillips estimate the worst case mass of rock that will be required at a single location will be 34,000 tonnes. Assuming this worst case volume will be required at the three locations for which the SSAs are to be finalised (Viking CD, Viscount VO and Vampire/ Valkyrie OD) and a contingency of 1,000 tonnes required at Vulcan UR, a total worst case mass of 204,500 tonnes of rock will be required at VDP1 and LDP1.

The berm designs for each location are similar but vary in height and surface area. For the largest berm design (Viking HD), 34,000 tonnes of rock will be placed in four adjoining locations on the seabed as a rock berm, to support each of the four AWV jack-up legs. The associated area of impact with this largest berm design is 7,884 m^2 (0.00788 km^2).

The Viking HD SSA estimates that each leg location will require at least 4.0 m of rock depth to provide sufficient resistance against punch-through. A slope gradient of 1 in 5 will be applied to the berm to provide adequate stability (Figure 3.11).



Source: GlobalMaritime (2015)

Figure 3.11: Cross-section of the proposed design of rock placement under each AWV leg at Viking HD

There are two vessels and associated methods for the placement of rock on the seabed that could be used for the VDP1 and LDP1 decommissioning activities:

- Side Stone Dumping Vessel (SSDV). SSDVs are self-propelled, with dynamic positioning (DP) systems which allow safe operation at close proximity to offshore platforms and structures. These vessels are typically used to install scour protection for offshore wind turbines and offshore rigs, to construct breakwaters or to install rock for subsea pipeline protection. The SSDVs and can handle many different rock types and sizes, ranging from small diameter crushed rock or gravel to large boulders weighing several tonnes each. Rock to be placed in on the seabed from a SSDV, is pushed over the side(s) of the vessel by a dozer blade, with rock deposited accurately in the water with the aid of a positioning system.
- Fall pipe vessel. Fall pipe vessels are primarily used for offshore projects, for covering pipelines and cables, levelling the seabed or applying scour protection. These vessels are highly computerised, dynamically controlled and can achieve position-fixing within an accuracy of less than half a metre. The graded rock on the vessel is fed into the fall pipe using a hopper system, with the length of the fall pipe varied to suit the water depth at the site. The end of the fall pipe is typically positioned within 5 m of the seabed. The hopper system controls the rate at which the rock is fed into the fall pipe, with a ROV confirming the correct positioning of the rock on the seabed.

A contractor for the placement of rock on the seabed for the proposed VDP1 and LDP1 decommissioning activities has been selected. ConocoPhillips has previously used a fall pipe vessel for rock-placement work in the southern North Sea and intends to utilise this

same method for VDP1 and LDP1 as it provides the most accurate deployment in high energy environments.

Based on the initial SSA results, the preliminary rock berm design is two-layered, overlying a filter layer of finer sediments (Layer 1) placed on the seabed (Table 3.26). The filter layer will prevent scouring of the underlying seabed by aiding in the prevention of the migration of the fine seabed sediments and loss of fines from “winnowing”. The mean rock grading of the upper layer (Layer 2) will be approximately 30 mm to ensure the rock berms stay relatively intact under storm conditions, while the coarser material of Layer 1 will prevent segregation of the sediments during placement (GlobalMaritime, 2015). The upper layers will be placed in a controlled manner by the rock-placement vessel.

Table 3.26: Preliminary rock berm design at Viking HD

Rock berm layer	Mean particle size (mm)
Layer 2 (gravel berm)	30.0
Layer 1 (coarser material)	1.0 – 5.0
Filter layer (fine material placed on seabed)	0.2

A direction for deposits application will be submitted to the DECC to seek approval to commence the rock-placement operations at each platform location. The volume of rock, method of installation and the site specific berm design will be detailed within each application, and will be based on the final SSA results. The rock requirement presented here is deemed to be a worst case and in reality, the quantities stated for the Viking CD, Viscount VO and Vampire/ Valkyrie OD locations (prior to completion of the SSAs) is anticipated to be less than the worst case required at Viking HD.

3.8.1 Topsides

ConocoPhillips will purge the topside systems to ensure that minimal hydrocarbons remain in the system prior to the final cleaning and disconnect (FC&D).

During the FC&D works all the systems will be progressively depressurised, purged and rendered safe for removal operations. Pipework and tanks may then be cleaned to remove sources of potential spills of oils and other fluids. Some FC&D operations, which do not compromise the well P&A activities or interfere with the life support systems and facilities, may begin during the well P&A programme**.** Vulcan UR will have its FC&D works completed in advance of the well P&A work using the (AWV), the remaining LOGGS and Viking satellites will already have had the wells P&A’d before the FC&D work commences.

Table 3.27 summarises the methods that will be used to flush, purge and clean the topsides offshore prior to removal to shore.

3.8.2 Jackets

The appointed lifting contractor will assess suitable locations for, and attachment of any new lifting points on the jacket structure.

Table 3.27: Cleaning of topsides for removal

Waste Type	Composition of Waste	Disposal Route
Onboard hydrocarbons	Process fluids.	Initial nitrogen purge with any fluids flushed downhole or skipped and shipped to shore. Any mobilised solids will be filtered and skipped to shore for onshore disposal.
Produced solids	Contaminated sand*, NORM.	Bulk produced solids will be removed, treated and disposed of onshore. Scale adhered to the internals of pipework and vessels will remain *in situ* and be treated and disposed of during the dismantling of the topside onshore.
Diesel	Bunkered diesel fuel.	Bunkered diesel will be drained and returned onshore for disposal.
Chemicals and lubricating oils	Production chemicals and lubricants for equipment, e.g., gearboxes, pumps, pedestal compressor skid.	Chemicals and lubricating oils will be drained and returned onshore for disposal.

Source: ConocoPhillips, 2014b

*the contaminated sand may contain hydrocarbons, heavy metals and NORM.

3.8.3 Pipelines

An internal analysis was undertaken to review feasible pipeline cleaning options and included:

1. Standard cleaning objective for pipeline decommissioning
    - clean and decommissioned *in situ*
    - clean and remove pipeline
    - fill pipeline with inert solid (cement) and decommissioned *in situ;*
2. Pig (solid or foam/ gel) or flush (with water or chemicals);
3. Direction of flow - to hub, to unmanned installation or a round trip to TGT;
4. Liquid disposal - into process stream, into a well or filtration and discharge to sea;
5. Solids disposal - into the process stream, into a well or landfill following filtering and collection on the platform.

Following initial discussions ConocoPhillips commissioned a cleaning technical note for the infield pipelines (Costain, 2014c). The purpose of this technical note was to identify the technically feasible options and assess these to determine the preferred cleaning option for the infield pipelines. The initial series of options assessed were as follows:

- Gas cleaning;
- Open cycle flush at low flow;
- Open cycle flush at high flow;
- Foam pig and gel; and
- Solid pig.

The worst-case pipeline scenario was considered to be between the ED and BD platforms, this having the longest single length at 12 km. In addition, the wellhead

compression would likely result in the highest quantities of solids being present within the pipeline.

Based on the analysis of the various cleaning options and the planned disposal routes, ConocoPhillips has decided that the infield pipelines should be initially flushed with seawater followed by the use of gel pigs. The direction of flushing is from the satellite to either a producing hub or adjacent satellite out with the scope of VDP1 and LDP1. The intention is to flush with seawater and use gel/ foam pigs to remove mobile hydrocarbons with minimal removal of solids. The flushing fluids will be filtered and mobile solids separated offshore. These solids would be collected for onward shipment to shore for treatment/ disposal. The flushing fluids would be re-injected downhole. There will be no planned overboard discharge of fluids or solids from the pipeline cleaning operations. The seawater flushes and gel runs will not remove all of the solids from the pipelines. These solids will be in the form of contaminated sands and NORM scale, as a result there will be some residual contaminated solids left in the pipelines. The pipelines will be left flooded with seawater following the cleaning operations.

3.8.4 Mattresses

ConocoPhillips commissioned a mattress inventory report to identify the number and where possible, the burial status of the mattresses in the VDP1 and LDP1 areas. There will be no additional preparatory work undertaken for the decommissioning of the concrete mattresses under VDP1 and LDP1.

3.8.5 T-piece

The T-piece will be flushed during the cleaning operations for the pipelines as this is integral in the pipeline infrastructure. There will be no additional preparatory work undertaken for the decommissioning of the T-piece under LDP1.

3.9 Selected Decommissioning Options for the VDP1 and LDP1 Facilities

ConocoPhillips undertook a formal CA of the VDP1 and LDP1 pipelines to determine a preferred decommissioning option. In addition, internal reviews and assessments were undertaken to determine the selected decommissioning options for the VDP1 and LDP1 platforms, wells and subsea structures.

Table 3.28 provides an overview of the selected decommissioning option for each of the VDP1 and LDP1 facilities, including those subject to a formal CA under the Petroleum Act 1998.

Table 3.28: Overview of selected decommissioning options for each facility

VDP1/ LDP1 Facility	Selected Decommissioning Option	Possible Decommissioning Methods
Topsides	Full removal	Single lift* and transportation to shore by a HLV, monohull crane vessel or a HLV for dismantlement, disposal and recycling.
Jacket (and risers)		
Pipelines	Decommissioned *in situ*	Minimal intervention.
Remaining mattresses	Minimal disposal option (decommissioned *in situ*)	
T-piece (LDP1 only)	Full removal	Cut and lift via a DSV, with a supply vessel on site.

Note: *****Depending on lifting contractor there is the option to lift both the jacket and topside together in a single lift operation.

3.10 Debris Clearance at the VDP1 and LDP1 Decommissioned Areas

ConocoPhillips plan to fully remove the T-piece, and the eight satellite platforms from the VDP1 and LDP1 areas, while the remainder of the facilities will be decommissioned *in situ* with minimal intervention.

Any major piece of equipment or material that is accidentally lost overboard during the proposed decommissioning programme will be located and retrieved.

3.10.1 Seabed clearance survey

On completion of the planned offshore programme of work, the seabed will be surveyed using side-scan sonar to ensure that it is clear of items or obstructions that might pose a safety risk to fisheries or other users of the sea.

Any significant oil and gas related seabed debris will be recovered for onshore disposal or recycling in line with existing disposal methods.

3.10.2 Verification of seabed clearance

After the removal of any oil and gas related debris, the VDP1 and LDP1 areas will be swept to verify that they are clear of obstructions. The sweeps will be carried out by an independent contractor, using specially-designed trawling equipment. The results of the sweeps and a copy of the seabed clearance certificate issued by the verifier will be submitted to DECC.

3.10.3 Final condition of the offshore site

Pipelines will be decommissioned *in situ* in their current location. Overtrawl surveys will determine whether any additional remedial work is required to ensure the pipelines are in a suitable state of burial at the point of decommissioning which allows fishing gear to pass over these pipelines unobstructed and without the potential of becoming snagged.

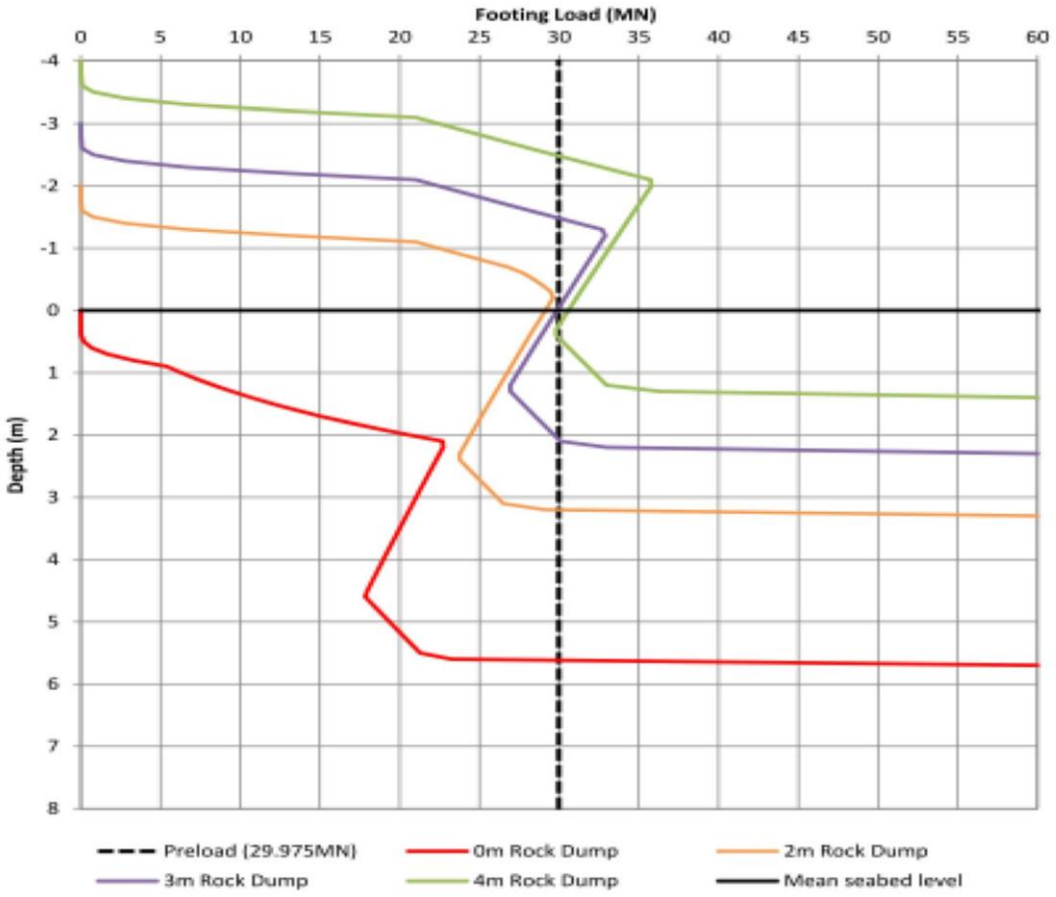
Existing concrete mattresses will remain *in situ* along the pipeline routes to maximise the re-use of existing stabilisation materials and minimise the introduction of new material (i.e., rock-placement). Over time, it is likely that these would be partially or fully covered by a layer of natural seabed sediment. Along the former route of the spools, the seabed will be free of significant oil and gas related debris.

Rock berms associated with the AWV will be left *in situ* following the completion of the decommissioning activities. A proportion of rock placed on the seabed under the AWV at platform locations will be pressed into the seabed with the weight of the AWV during the proposed operations. ConocoPhillips estimate each spud may penetrate approximately 1.5 m of a 4.0 m high rock berm, with the main bearing area fully embedded (Figure 3.12; GlobalMaritime, 2015). Areas of rock berm will remain on the seabed surface. Over time, it is likely that rock berm on the seabed surface would be partially or fully covered by a layer of natural seabed sediment. Overtrawlability surveys will be undertaken over the rock berms as part of the post decommissioning survey programme agreed with DECC.

The severed jacket piles will be located at a suitable depth below the natural level of the seabed as determined by the hydrodynamics present, currently estimated at 3 m below the seabed.

Any seabed depressions from anchors, jack-up legs or excavations will be surveyed to ensure these do not pose a snagging hazard to other users of the sea; this may also

involve overtrawl trials. These depressions will then be left to infill naturally as a result of the dynamic seabed conditions present across the VDP1 and LDP1 areas.



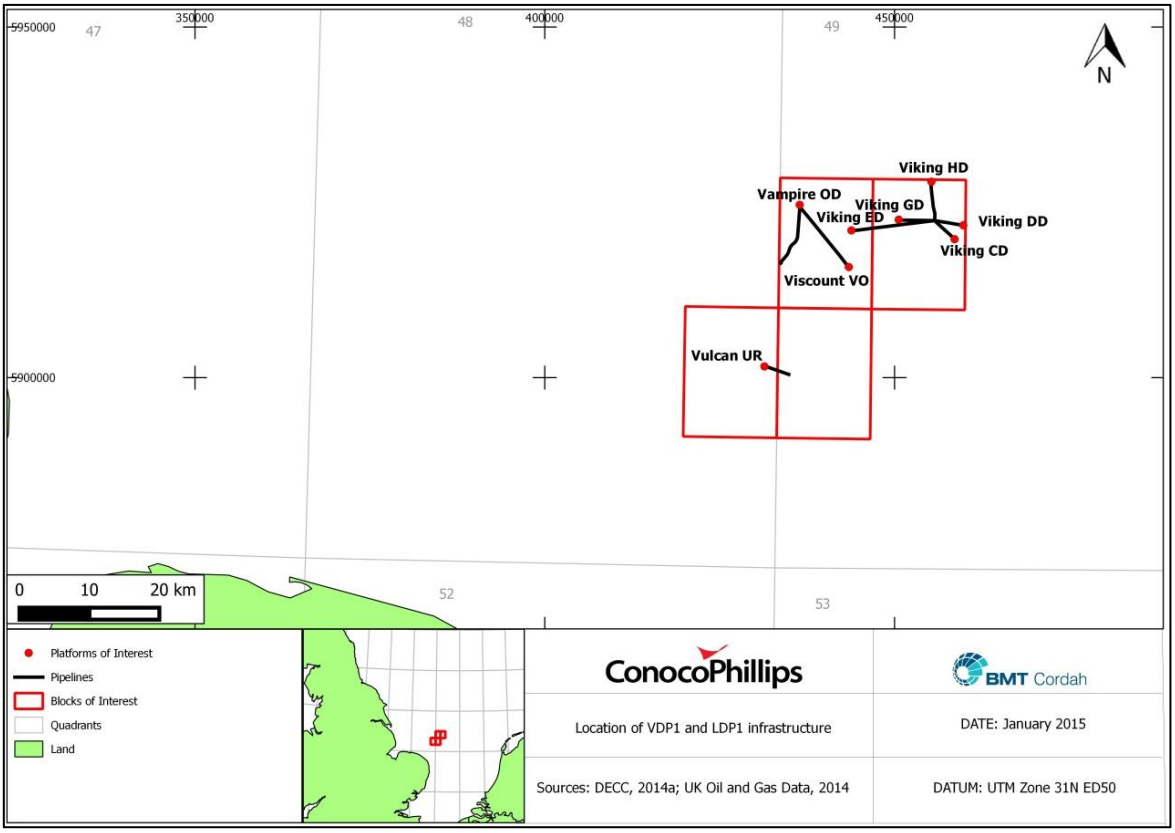
Source: GlobalMaritime, 2015

Figure 3.12: Predicted AWV leg penetration curve of the proposed rock berm comparing several depths of rock placement

4.0 ENVIRONMENTAL BASELINE

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

The infrastructure associated with VDP1 and LDP1 are located within Quadrants 48 and 49 of the SNS. Four UKCS licence blocks coincide with the infrastructure to be decommissioned (Blocks 48/25, 49/16, 49/17 and 49/21) (Figure 4.1).



Sources: DECC, 2014a; UK Oil and Gas Data, 2014.

Figure 4.1: The location of the SNS Phase 1 pipeline infrastructure to be decommissioned

4.1 Pre-Decommissioning Environmental Baseline Surveys (EBS)

Environmental baseline and habitat surveys were conducted at both the VDP1 and LDP1 platform locations (Table 4.1). These surveys were undertaken in a 2 x 2 km grid around each of the platforms surveyed and involved the collection of geophysical data (side scan and multibeam data), sediment sample retrieval and analysis, along with video and stills imagery of the seabed for ground truthing the data collected.

Table 4.1: Details of EBS baseline surveys undertaken

Survey	Platform	Survey Period	Survey Type
Fugro EMU Limited (2014a and 2014c)	Viking GD	May – June 2013	Analogue survey, habitat assessment, limited environmental baseline (5 stations), sediment analysis.
	Viking CD	May – June 2013	Analogue survey, habitat assessment, limited environmental baseline (5 stations), sediment analysis.
Fugro EMU Limited (2014b and 2014d)	Vulcan UR	May – June 2013	Analogue survey, habitat assessment, full environmental baseline (11 stations), sediment analysis.
	Vampire/ Valkyrie OD	May – June 2013	Analogue survey, habitat assessment, limited environmental (5 stations), sediment analysis.

The seabed sampling programme was undertaken using a Dual van Veen grab at four of the platforms included under VDP1 and LDP1 (two platforms in the VDP1 area and two platforms in the LDP1 area). There were 10 successful grabs at stations in the VDP1 area and 16 successful grabs at stations in the LDP1 area. The physico-chemical and macrofaunal characteristics of these samples were then analysed. Surface sediment samples were analysed for particle size, organic matter, hydrocarbons and heavy metal content. Sediments from stations located on the prevailing current (200 m from the platforms) were also analysed for tributyltin (TBT). Macrofaunal analysis (on 0.5 mm fraction) was carried out on duplicate samples with a further replicate stored for possible future analysis should there have been marked variation between the duplicate samples. There were no additional replicate samples analysed in either of studies. Figures 4.2 and 4.3 summarise the station locations for the physico-chemical and biological sampling programme.

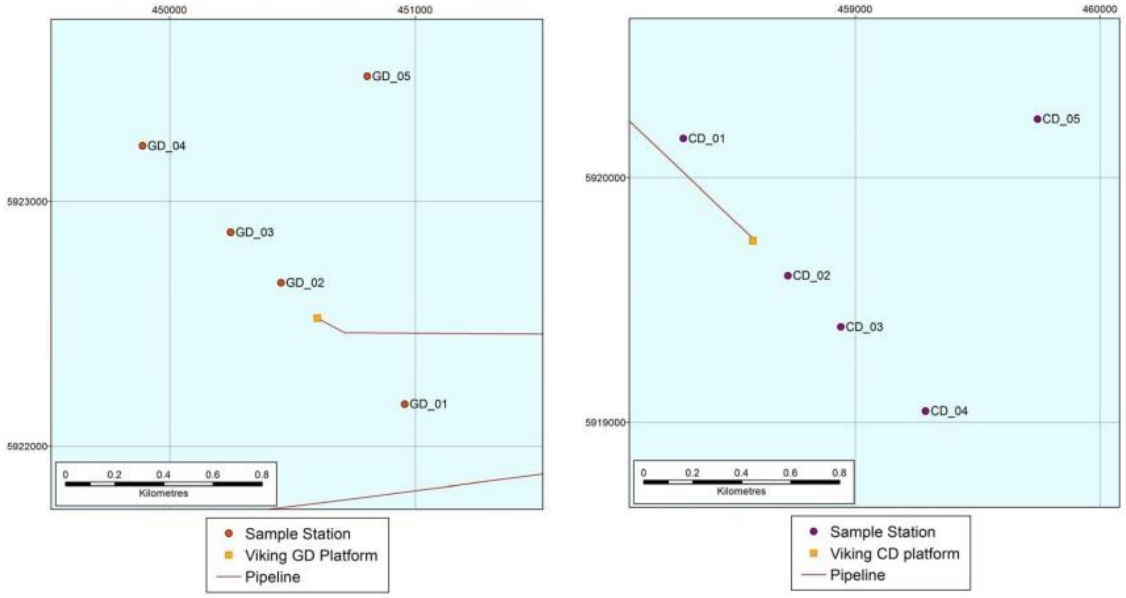


Figure 4.2: VDP1 area EBS station locations

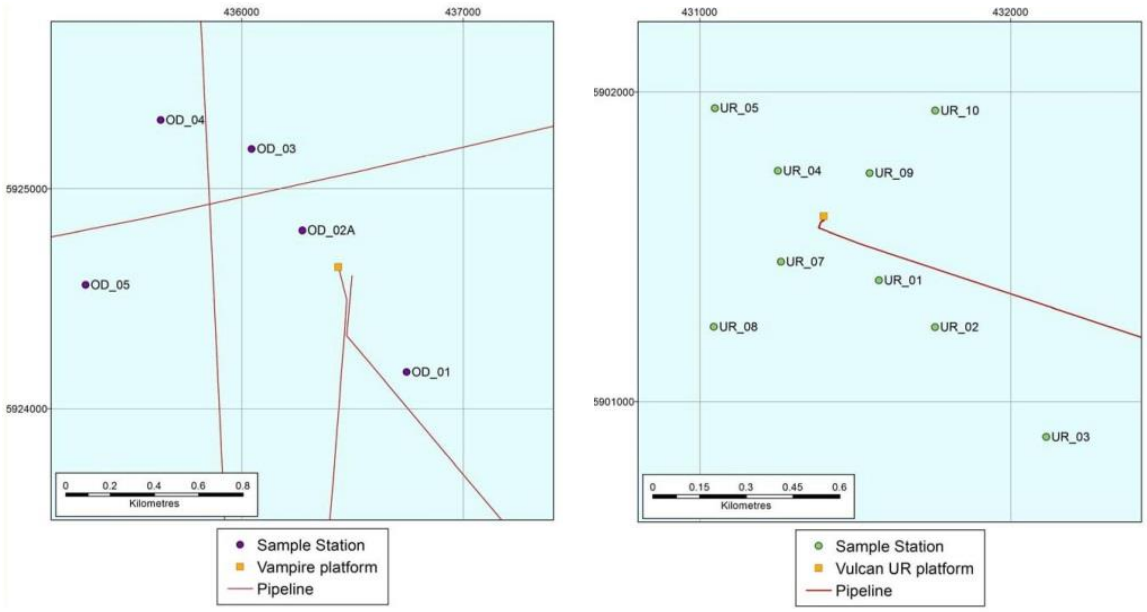


Figure 4.3: LDP1 area EBS station locations

A comparison of the analytical data and available references for the survey areas was also undertaken. In addition, statistical correlations were calculated for the chemical and biological elements analysed. The statistical analysis techniques were the Kendall rank correlation coefficient, multi-dimensional scaling, and the Spearman's rank correlation coefficient using the BIOENV algorithm in the PRIMER BEST routine.

The details of these surveys are presented in the following sub-sections.

4.1.1 Bathymetry

The VDP1 area ranges in depth from approximately 15 m to 36 m Lowest Astronomical Tide (LAT). There is a gentle slope across many of the sites ranging from 0.96º to 2.03º. The orientation of the slope is on the south-west to north-east axis. There are a number of features present on the seabed (Figure 4.4a and 4.4b); these range from wrecks, sand waves, megaripples, sand ripples, scour pits and shoal areas. These are all evidence of the highly dynamic nature of the seabed present across the area (Fugro, 2014a and 2014b).

The LDP1 area ranges in depth from 22 m to 37 m LAT. There was a gentle slope across the platform locations with the Vulcan site having an average of 1.68º whereas the Viscount and Vampire platform locations were more similar with 2.21º and 2.54º, respectively. There were several characteristic sand waves at the Vulcan UR platform location, these ranged in height from 0.8 m to 1.4 m, the longest of these sand waves was approximately 700 m. The Viscount platform area was characterised by the presence of megaripples with average amplitude of 0.3m and an average wavelength of 13m. The Vampire OD platform location is primarily characterised by the presence of large sand waves orientated north-east to south-west, these range in height from 1.3 m to 3.8 m. Figure 4.5 summaries some of the seabed features present across the sites (Fugro, 2014b and 2014d).

4.1.2 Seabed sediments and chemistry

The characteristics of the seabed at the sampling stations were consistent with the wider region and are summarised below. Since sediment chemistry is an important factor in the ecological investigations, chemical analysis was undertaken for numerous samples across the eight platform locations and the surrounding 2 km^2 areas relevant to VDP1 and LDP1 infrastructure (Table 4.2). The sediment chemistry in Table 4.2 also provides both background concentration values from the OSPAR Co-ordinated Environmental Monitoring Programme (CEMP), as well as effects range (ER) values which are used to assess the quality of coastal and estuarine environments and the ecological significance of the concentrations of hazardous substances found in sediment (USEPA, 2002; Long *et al,* 1998). The ER-Low (ERL) value is defined as the lower tenth percentile of the data set of concentrations in sediments which were associated with biological effects.

VDP1 area sediments

The VDP1 area sediments were classified as very poorly to moderately well sorted, fine sand to fine gravel. The silt/ clay and organic matter content were low across the sampling stations.

Gas chromatographic profiles of the surface sediments were generally similar across the sampling sites in the VDP1 area. These indicated that the hydrocarbons present were derived from a combination of weathered petroleum residues and a range of biogenic hydrocarbons typical of background southern North Sea sediments (Fugro, 2014a).

The total hydrocarbon concentrations (THC) were lower than previously recorded at the Viking A and other nearby locations. The THC values were also lower than the average background concentrations calculated from the environmental survey data collected between 1975 and 1995 in the southern North Sea (Fugro, 2014a).

All results for the organotins (Mono/Di/Tributyltin) were below the limit of detection for the analysis.

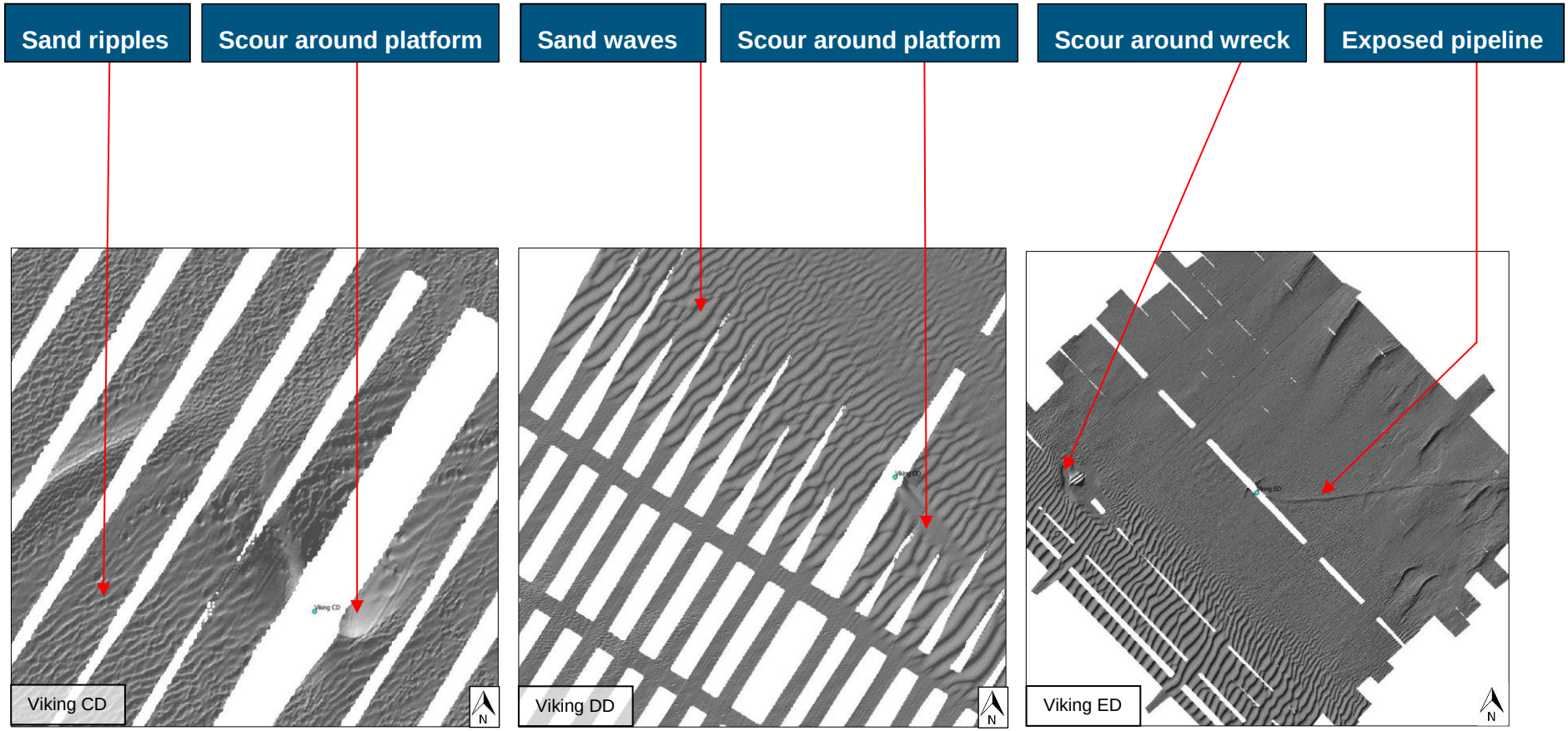
The concentrations of metals in the sediments were relatively constant throughout the survey area, except one sampling station at Viking GD which showed elevated levels of several metals (arsenic, barium, lead, vanadium, copper and zinc) analysed compared to other GD samples. This may be related to previous drilling related discharges at this location; however no obvious cuttings piles were evident on the seabed (Fugro, 2014a).

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 (Fugro, 2014a).

LDP1 area sediments

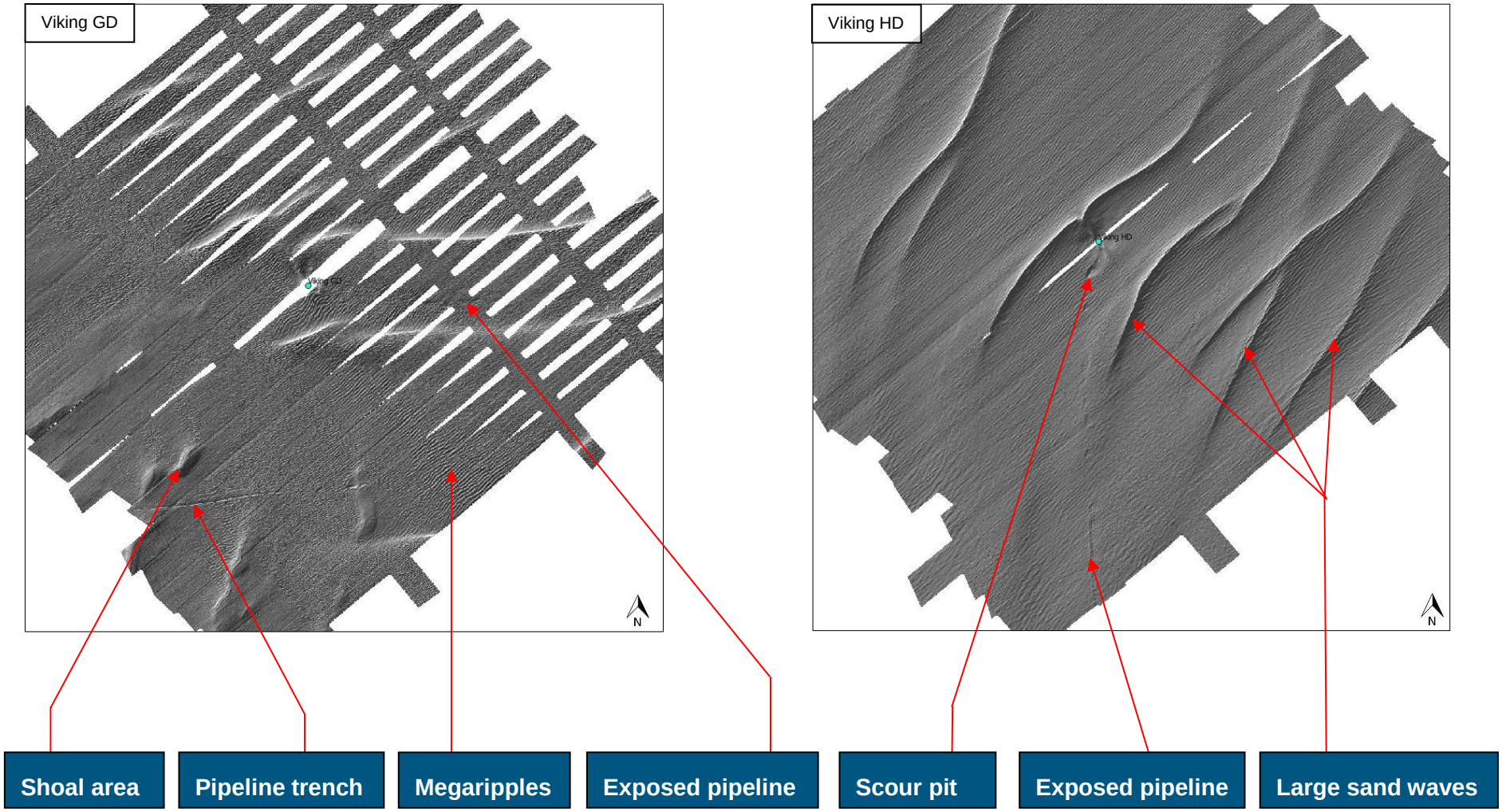
The LDP1 area sediments were classified from the EBS samples as very poorly to moderately well sorted, coarse to fine sands.

Gas chromatographic profiles for the surface sediments in the LDP1 area were generally similar to each other and contained a homologous series of n-alkanes ranging in carbon number from approximately nC_{12} to nC_{36} sitting upon a low level unresolved complex mixture (UCM). The profiles indicated that the hydrocarbons were derived from a combination of weathered petroleum residues and a range of biogenic hydrocarbons typical of southern North Sea sediments (Fugro, 2014b).



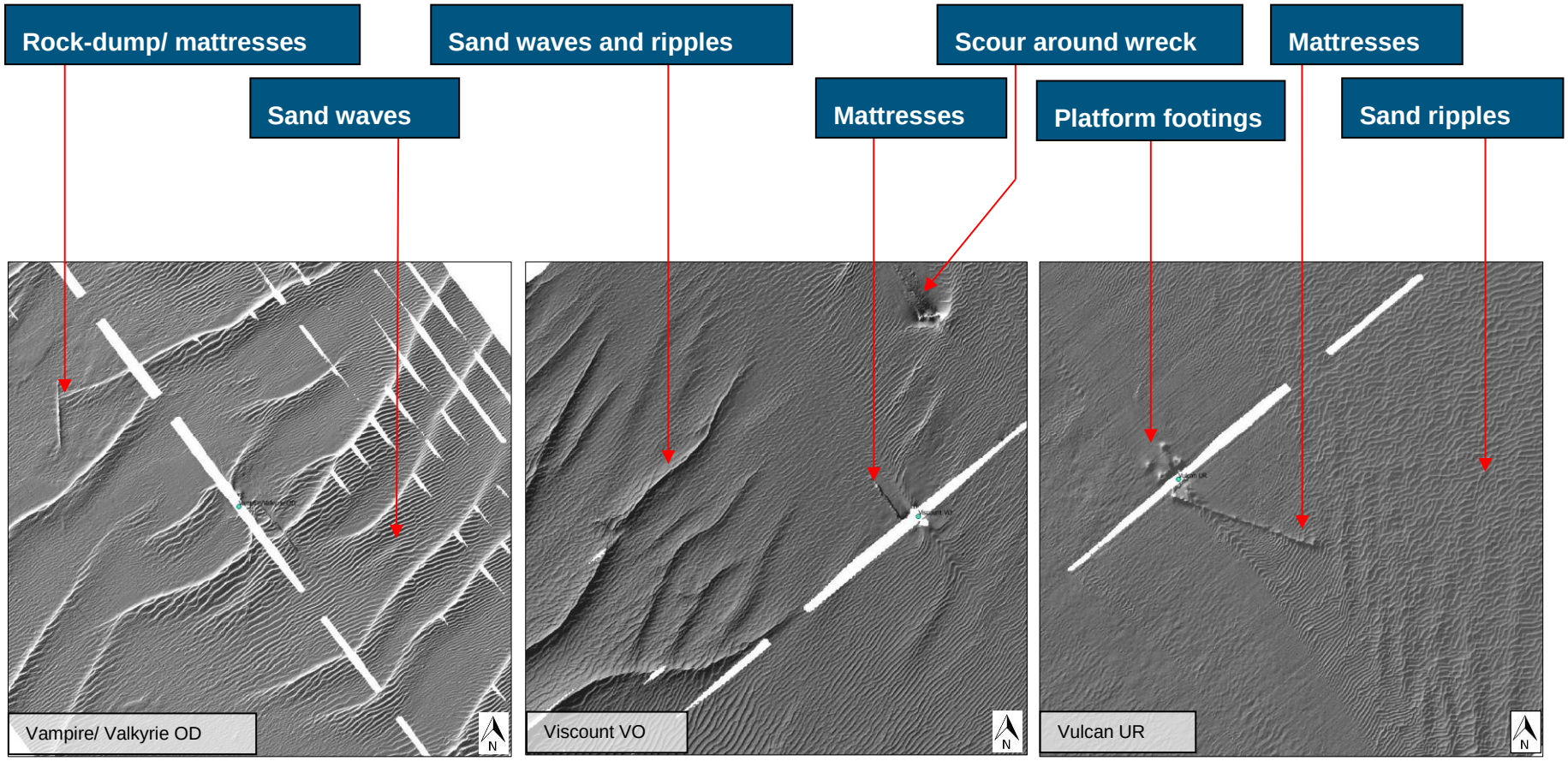
Source: Fugro, 2014a; Fugro, 2014b.

Figure 4.4a: VDP1 area platform seabed features



Source: Fugro, 2014a; Fugro, 2014b.

Figure 4.4b: VDP1 area platform seabed features continued



Source: Fugro, 2014a; Fugro, 2014b.

Figure 4.5: LDP1 area platform seabed features

Table 4.2: Specific chemistry information from sediment grabs from various platform locations

Reference	THC	As	Cr	Ni	Cu	Zn	Cd	Hg	Ba	Pb
Central North Sea (µgg^{-1} dry weight) (Min- Max range)										
Offshore (CEFAS, 2001a)	17-120	-	-	9.5	3.96	20.87	0.43	0.16	-	-
Oil and Gas Installations (CEFAS 2001a)	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)	21.28 (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
VDP1										
Viking CD	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	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
LDP1										
Vulcan UR	1.2 - 5.6	5.46 - 25.5	3.73 - 9.26	2.08 - 4.31	0.60 - 11.2	7.05 – 55.7*	0.01 - 0.02	<0.02	5 - 264	2.49 - 6.45
Vampire/ Valkyrie OD	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: *For Vulcan UR Zn, under OSPAR (2005), maximum expected background concentration (BC), normalised to 5% aluminium if the environment was pristine
(-) means no data currently available.
UKOOA (2001) values are mean with the 95th percentile shown in parenthesis.

On the 135º to140º bearing from the Vulcan UR platform there was evidence of drilling related hydrocarbon contamination, the n-alkane levels at the Vampire OD platform were higher in comparison to the UCM than observed at the Vulcan UR platform. However no obvious cuttings piles were evident (Fugro, 2014b).

The THC measured were mostly below levels previously recorded at the sites and were mostly lower than or similar to, the average background concentration calculated from environmental survey data collected between 1975 and 1995 in the southern North Sea (Fugro, 2014b). The exception to this was station UR_01 at the Vulcan platform where there was elevated total hydrocarbons at 5.6 $\mu g g^{-1}$. Chromatogram analysis of this sample indicated the presence of some drilling related material, in this case an Enhanced Mineral or Low Toxicity Oil Based Fluid (EMOBF/ LTOBF). Traces of this EMOBF/ LTOBF were also identified at stations UR_02 and UR_03 that extended out to 1,000 m from the platform on the residual current as detailed above.

The concentrations of metals in the sediments were relatively constant throughout the survey areas and were within ranges measured at other locations during the environmental baseline surveys. Comparison with cited metal concentrations data indicates that the survey data were of no obvious environmental concern and could be generally ascribed as within the range of natural background concentrations (Table 4.2; Fugro, 2014b). It should be noted that slightly elevated levels of arsenic were reported at two of the sampling locations.

4.2 Physical Environment

This section describes the physical and oceanographic details of the environment around the VDP1 and LDP1 decommissioning areas.

4.2.1 Waves

Significant wave heights in the vicinity of the VDP1 and LDP1 infrastructure exceeded 2.5 meters for only 10% of the year. However there is evidence of considerable seasonal variation between sea states, with waves in excess of 4 meters 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 (ConocoPhillips, 2005).

4.2.2 Water circulation and tides

The VDP1 and LDP1 infrastructure is located in an area influenced by southern North Sea current and the Channel current. 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). This prevents the formation of a thermocline and results in a highly dynamic marine environment (Lee and Ramster, 1981).

Tidal current velocities over the VDP1 and LDP1 areas are stronger than those in the northern (0.11 to 0.25 m/s) and central (0.18 to 0.36 m/s) North Sea, at between 0.39 m/s (neap tides) and 0.86 m/s (spring tides) (ABPmer, 2008).

Currents in the vicinity of the sandbanks can be highly affected by their presence. Indeed, 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 (ConocoPhillips, 2005).

4.2.3 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 54º N 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 (ConocoPhillips, 2003 and 2005). Due to the mixing at these shallow depths there is little variation in salinity with depth.

Mean sea surface temperature across the VDP1 and LDP1 areas is approximately 13.5 °C in summer and 5 °C in winter. Mean bottom water temperature is approximately 15 °C in summer and 5 °C in winter. The salinity of the water column is around 34.5 ppt throughout the year (UKDMAP, 1998).

4.2.4 Wind

Seasonal wind roses for the VDP1 and LDP1 areas have been provided in Figures 4.6 and 4.7. These are derived from data presented in the ConocoPhillips Valkyrie extension ES (ConocoPhillips, 2003), which is centrally located between the VDP1 and LDP1 areas.

Although there is some seasonal variation in wind direction the predominant wind direction is south-westerly. From April to July the prevailing wind are north-northeast (ConocoPhillips, 2003).

4.2.5 Air quality

An understanding of the existing air quality in the area of the 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 from vessels during operations. Further information on air quality and energy and emissions is provided in Section 7.

4.2.6 Seabed environment

The VDP1 and LDP1 infrastructure lie in an area of the SNS where sediment comprises fine to coarse sands, often silty and with variable amounts of shell fragments and occasional pebbles and cobbles. The highly dynamic marine environment restricts the silt and clay content to less than 15% (Fugro, 2014a and 2014b). The dynamic marine environment is thought to have resulted in the redistribution of drill cuttings piles (Section 4.1.2) from around wellheads in the vicinity of the VDP1 and LDP1 installations.

The seabed habitat of the VDP1 and LDP1 areas is classified using the European Nature Information System (EUNIS) code A5.2: “Sublittoral, clean medium to fine or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets”. This shallow-water infaunal assemblage is typically characterised by taxa including polychaetes, bivalve molluscs and amphipods and crustaceans (Fugro 2014a and 2014b).

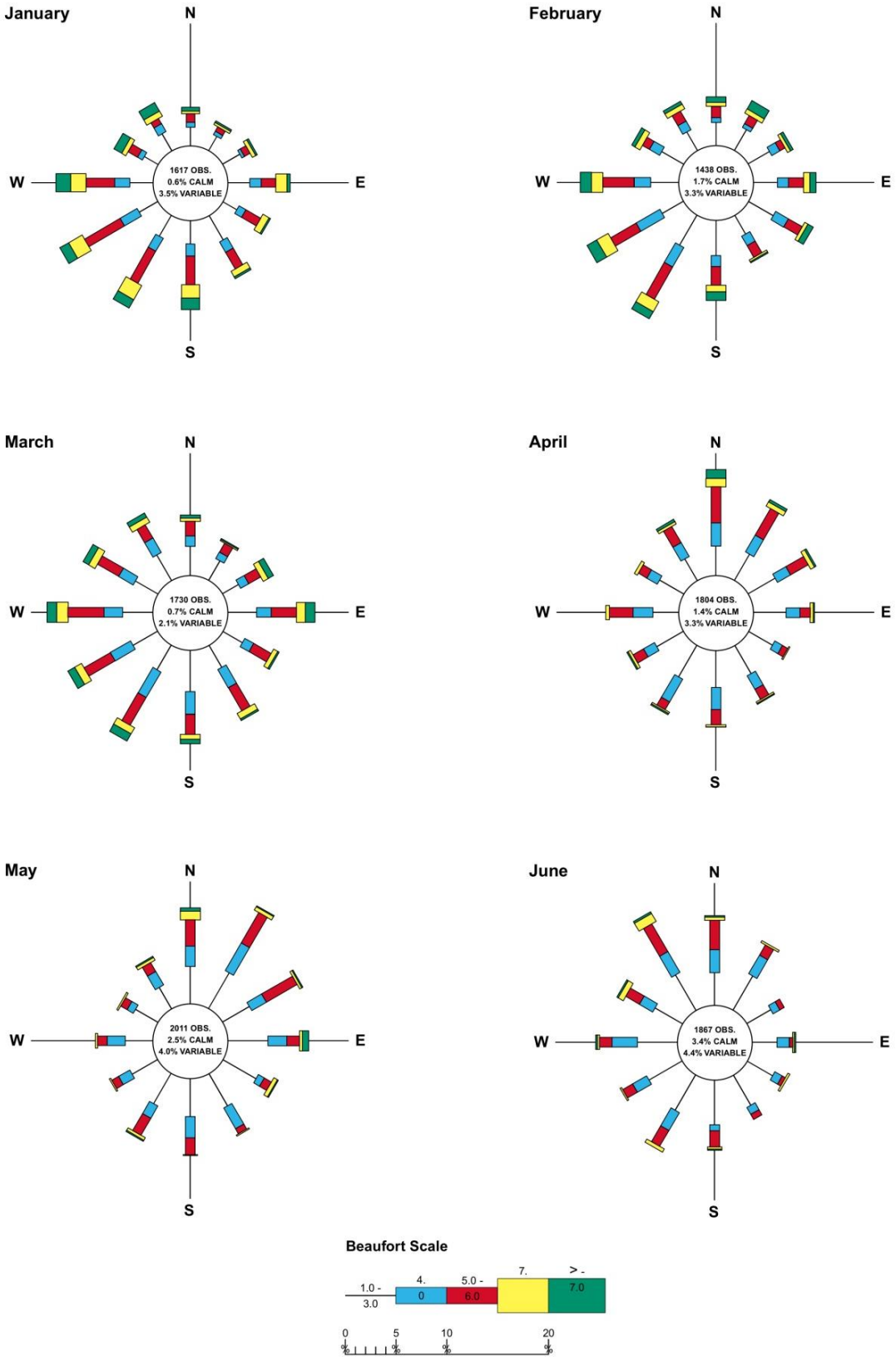


Figure 4.6: Seasonal wind roses for the VDP1 and LDP1 areas (January to June)

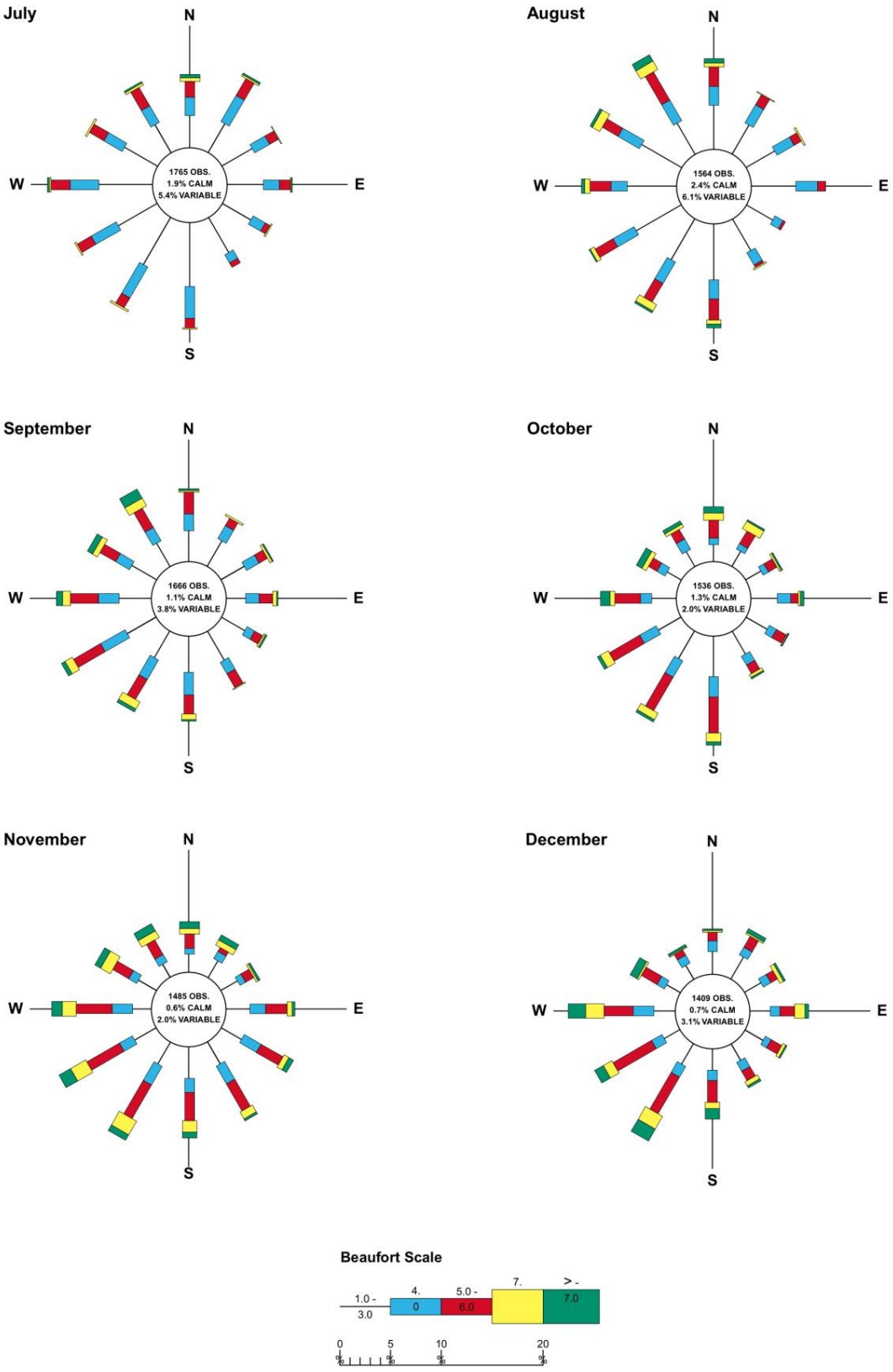


Figure 4.7: Seasonal wind roses for the VDP1 and LDP1 areas (July to December)

Numbers of taxa, individuals and diversity across the sampling locations of the 2013 surveys (Fugro 2014a and 2014b) were low to moderate. Dominant taxa across the survey area were typical of the mobile sand and coarser sediments present across the decommissioning area (excluding a station at the Vulcan UR site), 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 were sparse. The benthic community at the Vulcan platform station was found to be dominated by species associated with fine sands and muds, namely *Mediomastus fragilis*, *Goniada maculata*, *Galathowenia oculata*, *Anobothrus gracilis* and molluscs (*Kurtiella bidentata* and *Abra alba*).

Sabellaria spinulosa were identified in several historical survey reports within and adjacent to the areas containing VDP1 and LDP1 infrastructure (Conoco, 1998 and 2002; ConocoPhillips, 2005 and 2008; Venture, 2006). There was evidence in the Fugro (2014a and 2014b) reports of *S. spinulosa*; however this was sparse and fragmented. Indications from the reviewed 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" (BMT Cordah, 2014b). 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* would not constitute a reef.

4.3 Conservation Status of Decommissioning Areas

Table 4.3 lists Annex I habitats and Annex II species of the European Union Habitats Directive (92/43/EEC) that have been considered for the identification of Special Area of Conservation (SAC) relevant to this decommissioning project. SACs are sites that have been adopted by the European Commission (EC) and formally designated by the government of each country in whose territory the site lies and SCIs are sites that have been adopted by the EC but not yet formally designated by the government of each country.

The VDP1 and LDP1 infrastructure to be decommissioned during Phase 1 are located within the North Norfolk Sandbanks and Saturn Reef SCI, which is currently under consideration as a UK SAC and has been raised to the designation of SCI (Figure 4.8) (JNCC, 2014a). Annex I habitats occurring within this SCI include sandbanks that radiate northeast parallel to the Norfolk coast. The sandbanks typically have fields of sand waves associated with them, the amplitude of which decreases with distance from the shore. Also present are Annex I biogenic reef habitats formed by the polychaete worm *S. spinulosa* (Table 4.3).

Figures 4.4a, 4.4b and 4.5, demonstrate the presence of some of these Annex I habitat (sand bank) features which are present at the platform locations. It is expected that similar features are present across the wider area within the blocks of interest.

Sediment sampling of the area around VDP1 and LDP1 platforms was undertaken as part of a pre-decommissioning environmental baseline survey in 2013 (Fugro, 2014a, 2014b, 2014c and 2014d). Presence of Annex 1 habitats (sandbank habitat) at the Vampire/ Valkyrie survey area was evident; however as the water depth at survey area is >20 m, these are likely to be edges of sandbanks. Four areas were identified (three at

Vulcan UR and one at Viscount VO) as potentially being *S. spinulosa* reef however on ground truthing the sites, all areas at Vulcan were discounted and were found to only have flattened aggregations and not a habitat that would be classed as a reef (Fugro 2014a, 2014b, 2014c and 2014d).

Table 4.3: Annex I habitats and Annex II species which are qualifying features for SAC and SCI designations in the vicinity of the VDP1 and LDP1 infrastructure

Annex I habitats considered for SAC selection in UK offshore waters	Species listed in Annex II known to occur in UK offshore waters
• Sandbanks that are slightly covered by seawater all the time***** • Biogenic reefs – formed by the polychaete worm *S. spinulosa****** • Submarine structures made from leaking gases	• Harbour porpoise (*Phocoena phocoena*) • Bottlenose dolphin (*Tursiops truncates*) • Common seal (*Phoca vitulina*) • Grey seal (*Halichoerus grypus*)

Note: * Primary reason for SAC/ SCI designation.

Sources: JNCC, (2014a-f); Johnston *et al*., 2002.

Annex II species sighted within the VDP1 and LDP1 decommissioning areas (UKCS Quadrants 48 and 49) include the harbour porpoise, which has been sighted in very high numbers in August, in September in high numbers, and in March in moderate numbers. For the months; February, April, May and October, numbers of harbour porpoise were recorded as low. No sightings recorded in January, June, July or December (Reid *et al*., 2003; UKDMAP, 1998). Common seals have been observed throughout Quadrants 48 and 49 (Jones *et al*., 2013). These species are discussed further in Section 4.6.

4.3.1 Special Conservation Areas and Sites of Community Interest

The following inshore and offshore SACs and SCIs are located within 70 km of the VDP1 and LDP1 decommissioning areas (Figure 4.8).

- The Wash and North Norfolk Coast Inshore SAC (at its closest, approximately 65 km west of the Vulcan UR platform) designated for: Sandbanks which are slightly covered by seawater all the time; mudflats and sandflats not covered by seawater at low tide; large shallow inlets and bays; reefs; Salicornia and other annuals colonizing mud and sand; Atlantic salt meadows; Mediterranean and thermo-Atlantic halophilous scrubs and harbour seals (JNCC, 2014b).
- Haisborough, Hammond and Winterton Offshore SCI (approx. 26 km south of the Vulcan UR platform; Figure 4.5) designated for sandbanks which are slightly covered by seawater all the time and *S. spinulosa* reef habitats (Table 4.3; JNCC, 2014c).
- The Inner Dowsing, Race Bank and North Ridge SCI (approx. 63 km west of the Vulcan UR platform) is also designated for its sandbanks which are slightly covered by seawater all the time and *S. spinulosa* reef habitats (Table 4.3; JNCC, 2014d).

There are no other designated protected areas (Marine Conservation Zones) within 100 km of the VDP1 and LDP1 decommissioning areas. However, the following five recommended Marine Conservation Zones (rMCZs; JNCC, 2015) are located with 75 km of the VDP1 and LDP1 decommissioning areas:

- Holderness Offshore rMCZ.
- Silver Pit rMCZ.
- Wash Approach rMCZ.
- Cromer Shoal Chalk Beds rMCZ.

- Markham's Triangle rMCZ.

4.3.2 Special Protection Areas (SPAs)

Special Protection Areas (SPAs) are protected areas which have been classified in accordance with Article 4 of the EC Birds Directive. They are classified based on the location of rare and vulnerable birds and also for frequently occurring migratory species which are listed on Annex 1 of the Directive.

The infrastructure included in VDP1 and LDP1 does not transect any SPAs, however the following coastal SPAs occur within 70 km along the adjacent Norfolk, Lincolnshire and East Yorkshire coastline.

The Outer Thames Estuary Inshore SAC (approx. 68 km south of the Vulcan UR platform) is designated for the protection of the Red-throated diver, *Gavia stellate*. The area is estimated to be used by 38% of the UK population in the non-breeding season, which visit the area to feed on the local fish populations (JNCC, 2014e).

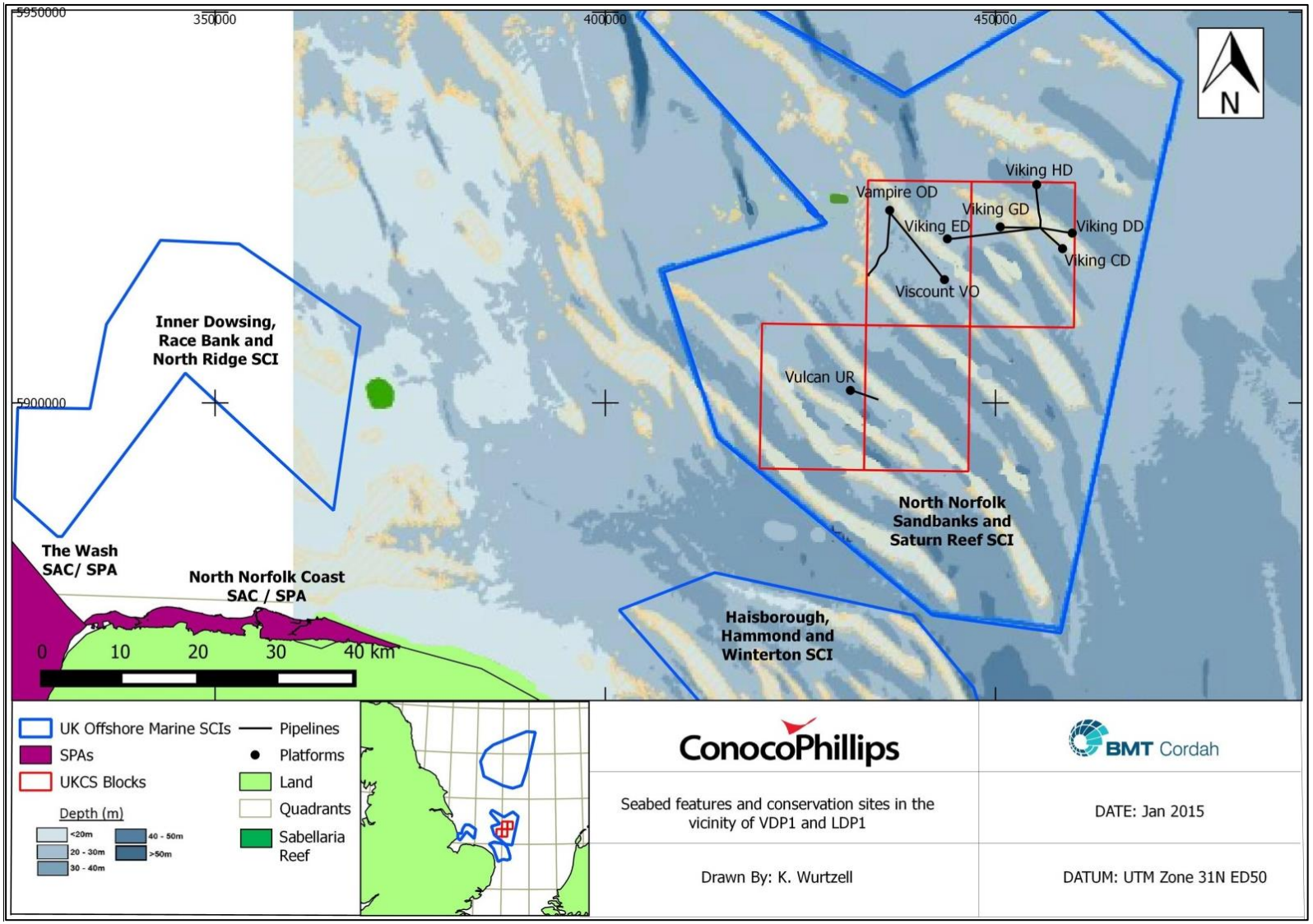
The North Norfolk Coast SPA (65 km southwest of the Vulcan UR; Figure 4.5) has a great diversity of high-quality freshwater, intertidal and marine habitats results in very large numbers of waterbirds occurring throughout the year. In summer, the site holds large breeding populations of waders, four species of terns, bittern (*Botaurus stellaris*) and wetland raptors. In winter, the coast is used by very large numbers of geese, sea-ducks, other ducks and waders. The coast is also of major importance for waterbirds in the spring and autumn migration periods. Breeding terns and wintering sea-ducks regularly feed outside the SPA in adjacent coastal waters (JNCC, 2014f; Figure 4.8).

4.4 Finfish and Shellfish

VDP1 and LDP1 are located within spawning grounds for mackerel (*Scomber scombrus*; May to August), cod (*Gadus morhua*; January to April), whiting *(Merlangius merlangus*; February to June), plaice *(Pleuronectes platessa*; January to March), lemon sole (*Microstomus kitt*; April to September), sole (*Solea solea*; March to May), sandeel (*Ammodytidae sp*.; November to February), sprat (*Sprattus sprattus*; May to August) and *Nephrops* (*Nephrops norvegicus*; throughout the year). The plaice spawning area within the vicinity of the decommissioning areas is considered to be a part of an important spawning area for this species, with a relative high intensity spawning recorded from the International Council for the Exploration of the Sea (ICES) fish survey data (Ellis *et al*., 2012; Coull, *et al*., 1998) (Figures 4.9 to 4.11).

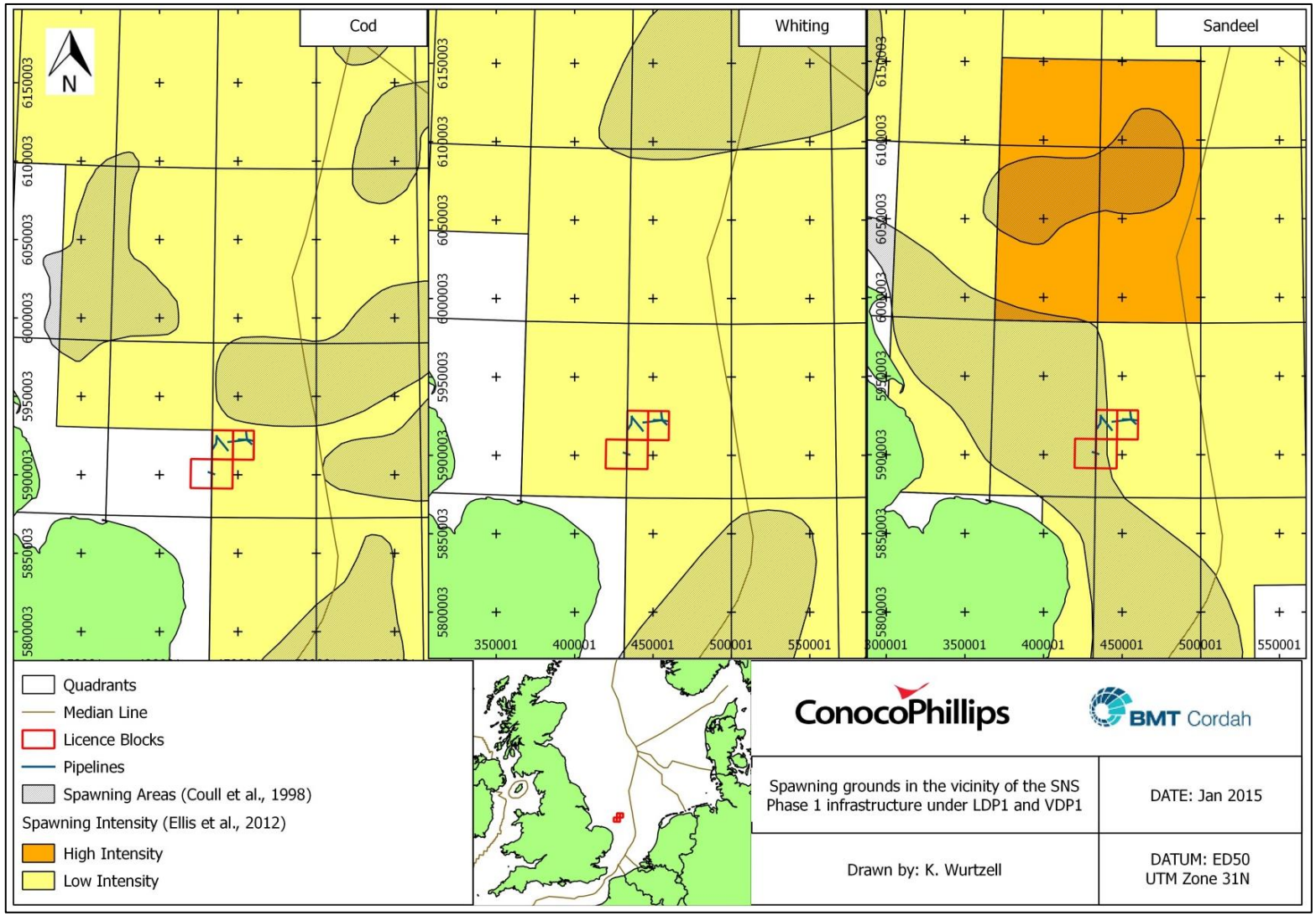
The VDP1 and LDP1 infrastructure also lies within the nursery grounds throughout the year for mackerel, herring (*Clupea harengus*), cod, whiting, plaice, lemon sole, sandeel, *Nephrops,* tope shark (*Galeorhinus galeus*), sprat, sole and horse mackerel (Aires *et al*, 2014; Ellis *et al*., 2012; Coull, *et al*., 1998) (Figures 4.12 to 4.13).

Recent data from Aires *et al.* (2014) indicates the probable presence of Age 0 group fish using previously identified nursery grounds data from Coull *et al*. (1998) and environmental habitat variables. Age 0 group fish are defined as fish in the first year of their lives and can also be classified as juveniles. The data indicates the probability of the presence of Age 0 group fish for species that have defined and predictable environmental habitat specifications for the development of juveniles.



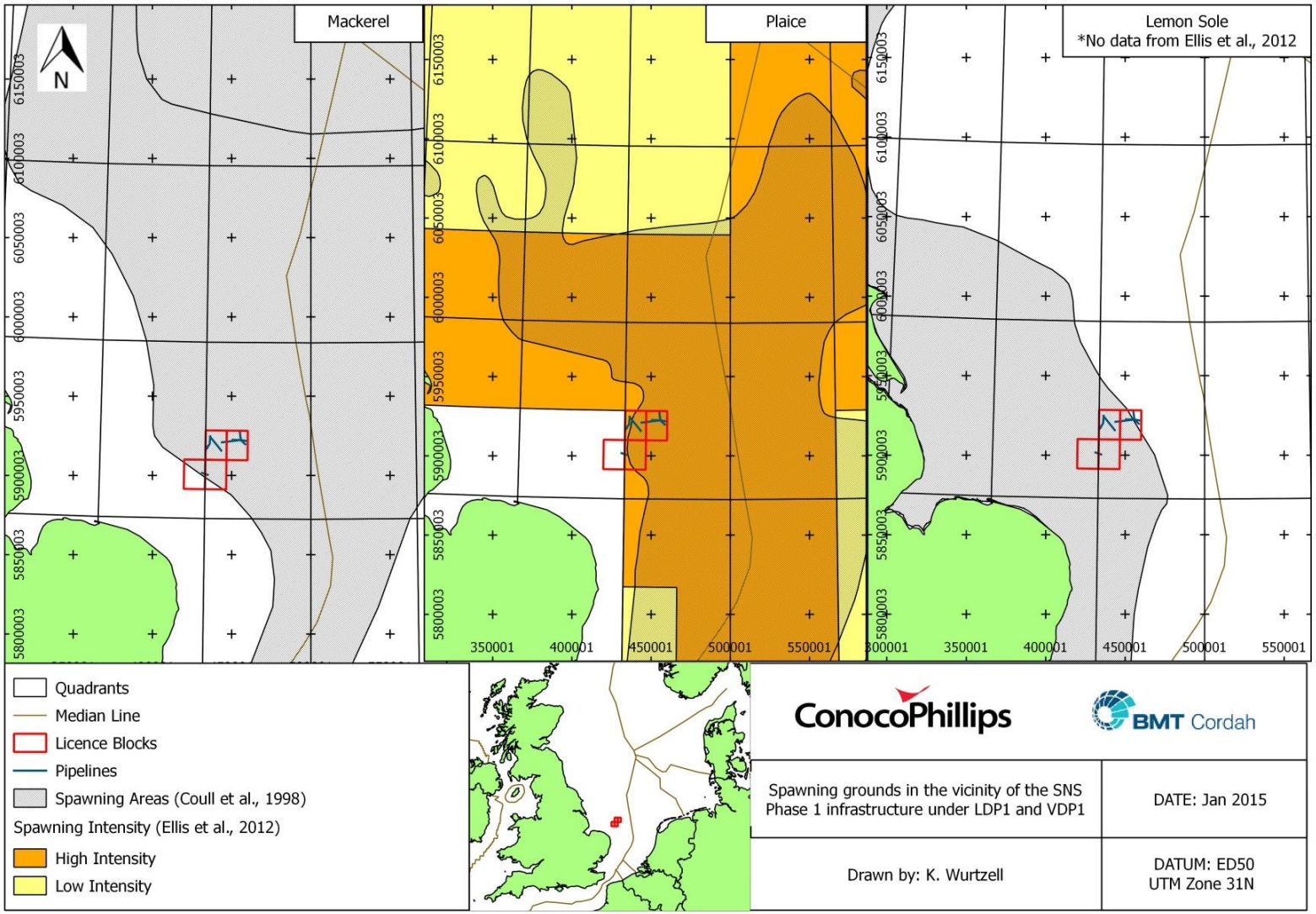
Sources: MMO, 2015; DECC, 2014a; JNCC, 2010a; UK Oil and Gas Data, 2014.

Figure 4.8: Conservation areas and seabed features associated with the VDP1 and LDP1 decommissioning areas



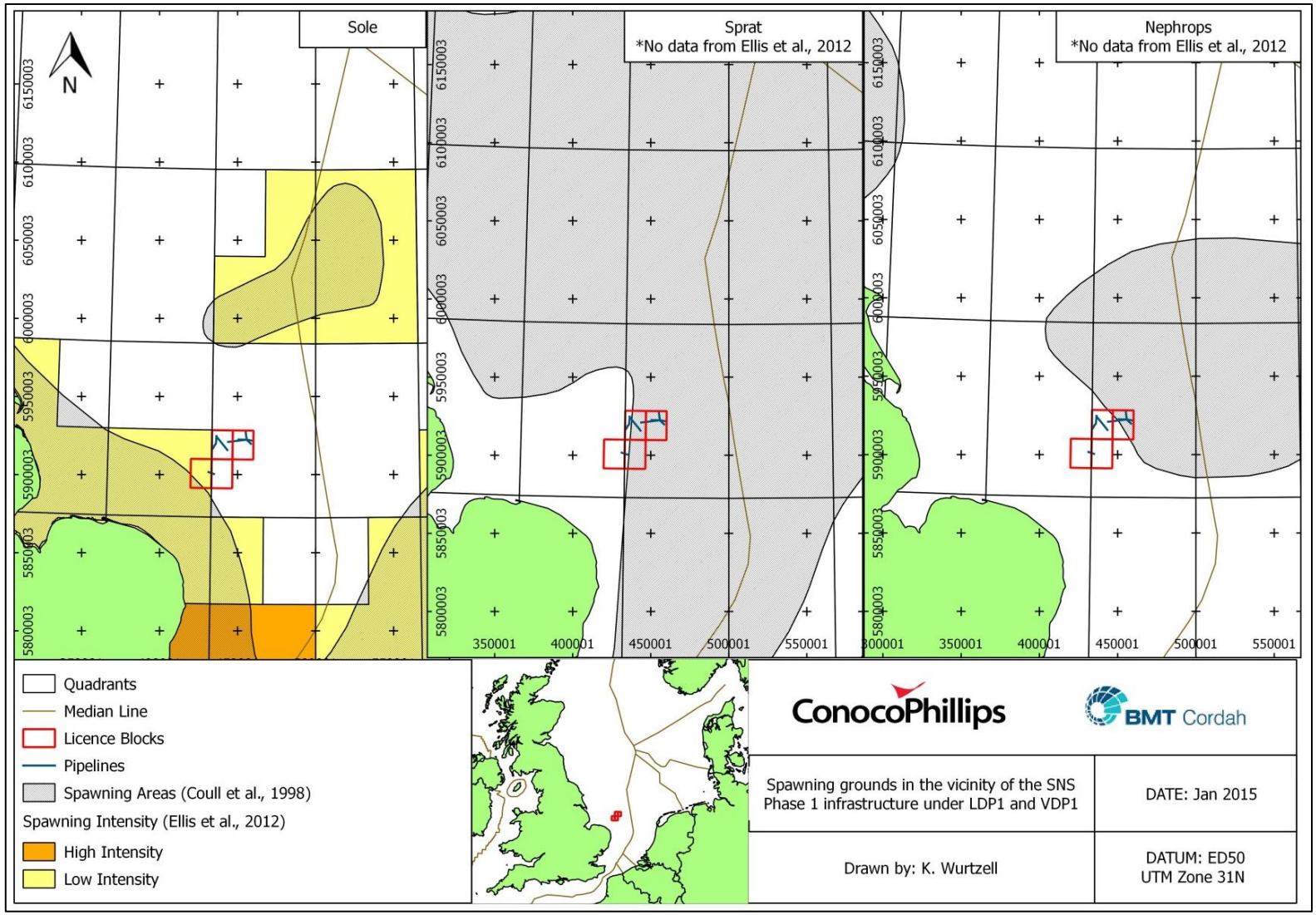
Sources: DECC, 2014a; UK Oil and Gas Data, 2014; Coull *et al.*, 1998; Ellis *et al.*, 2012.

Figure 4.9: Spawning grounds for cod, whiting and sandeel in the vicinity of the VDP1 and LDP1 decommissioning areas



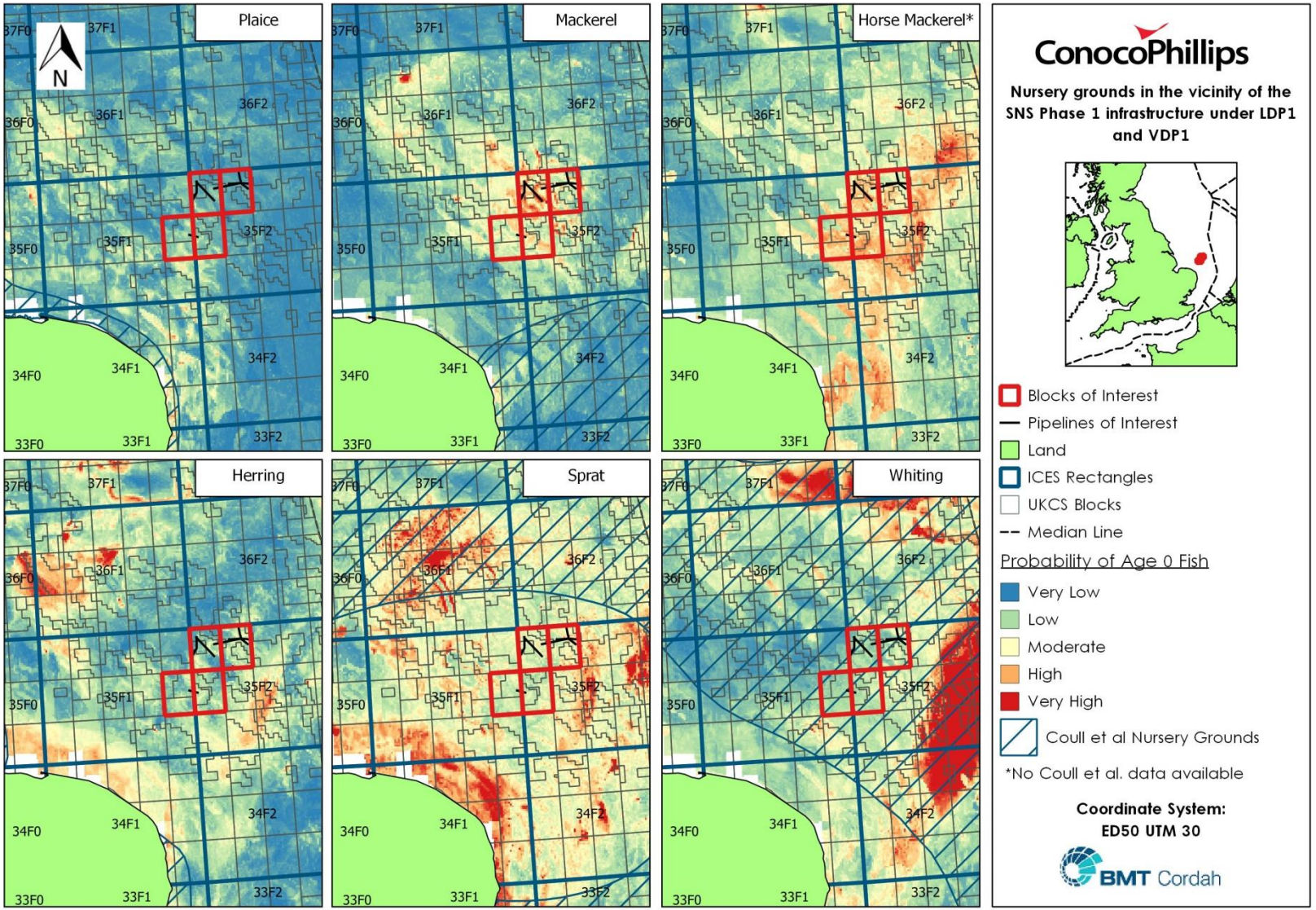
Sources: DECC, 2014a; UK Oil and Gas Data, 2014; Coull *et al.*, 1998; Ellis *et al.*, 2012.

Figure 4.10: Spawning grounds for mackerel, plaice and lemon sole in the vicinity of the VDP1 and LDP1 decommissioning areas



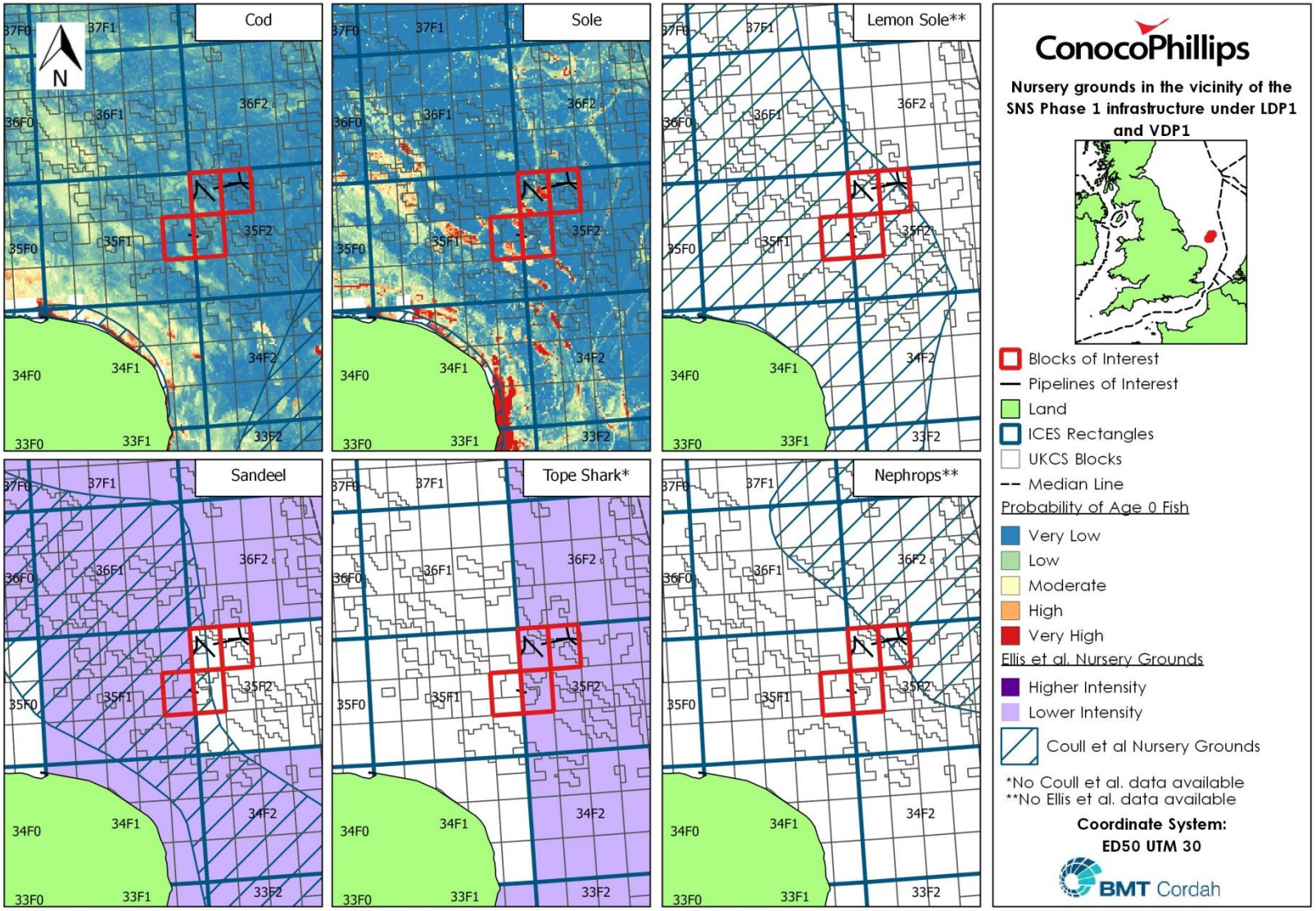
Sources: DECC, 2014a; UK Oil and Gas Data, 2014; Coull *et al.*, 1998; Ellis *et al.*, 2012.

Figure 4.11: Spawning grounds for sole, sprat and *Nephrops* in the vicinity of the VDP1 and LDP1 decommissioning areas



Sources: DECC, 2014a; UK Oil and Gas Data, 2014; Coull *et al.*, 1998; Ellis *et al.*, 2012; Aires *et al.,* 2014

Figure 4.12: Nursery and juvenile grounds for plaice, mackerel, horse mackerel, herring, sprat and whiting in the vicinity of the VDP1 and LDP1 decommissioning areas



Sources: DECC, 2014a; UK Oil and Gas Data, 2014; Coull *et al.*, 1998; Ellis *et al.*, 2012; Aires *et al.,* 2014

Figure 4.13: Nursery and juvenile grounds for cod, sole, lemon sole, sandeel, tope shark and *Nephrops* in the vicinity of the VDP1 and LDP1 decommissioning areas

Species that have been indicated to have a presence of Age 0 group (juvenile) fish (Aires *et al.,* 2014) in the vicinity of VDP1 and LDP1 infrastructure are presented within Figures 4.12 and 4.13. Figures 4.12 and 4.13 also present indicative Coull *et al.*, 1998 and Ellis *et al.*, 2012 nursery grounds. Where areas of presence from both data sets overlap there is a greater probability that the area is either a spawning or nursery ground. The Ellis *et al.* (2012) data provide an insight into the intensity of the spawning or nursery area based on the data gathered from research surveys conducted within ICES rectangles in the area.

4.5 Seabirds

Seabirds found in offshore North Sea waters include fulmars (*Fulmarus glacialis*), gannets (*Morus bassanus*), auks, gulls, and terns (DTI, 2001). 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).

In the LDP1 and VDP1 areas, the overall seabird vulnerability to surface pollution is moderate (JNCC, 1999). The most sensitive times of year are March and November when vulnerability to oil pollution is very high. In some of the area June and July data, where available, indicate low vulnerability and the remainder of the year ranges from high to low (Table 4.4).

Table 4.4: Seabird vulnerability within and surrounding the area of the VDP1 and LDP1 decommissioning

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
49/16*	3	2	1	2	3	4	ND	3	3	2	2	3
49/17*	3	2	1	2	3	4	ND	3	3	2	2	3
49/21*	4	2	2	4	3	4	4	3	4	3	4	2
48/25*	4	2	2	4	3	4	4	3	4	2	2	2
49/22	4	2	2	4	3	4	4	3	4	3	4	2
49/11	3	2	1	2	3	ND	ND	3	3	2	2	4
49/12	3	2	1	2	3	ND	ND	3	3	2	2	4
48/19	3	2	1	3	3	ND	ND	2	3	2	1	3
48/20	3	2	1	2	3	4	ND	2	3	2	1	3
49/18	2	2	1	2	3	4	4	3	3	2	2	3
49/23	3	2	2	4	3	4	4	3	4	3	4	2
49/26	4	3	3	4	3	4	4	3	4	3	4	2
49/27	4	3	3	4	3	4	4	3	4	3	4	2
49/28	4	3	2	4	3	4	4	3	4	3	4	2
48/14	3	2	1	3	3	ND	ND	2	3	2	1	3
48/15	3	2	1	2	3	ND	ND	2	3	2	1	3
48/24	4	2	3	4	3	4	4	3	4	2	2	2
48/29	4	3	4	4	4	4	4	3	4	2	2	2
48/30	4	3	3	4	3	4	4	3	4	2	2	2

KEY:

1	Very high seabird vulnerability
2	High seabird vulnerability
3	Moderate seabird vulnerability
4	Low seabird vulnerability
ND	No data

Note: *Blocks in red indicate blocks containing infrastructure to be decommissioned.
Source: JNCC, 1999.

As part of the Marine Management Organisation's (MMO) East Inshore and Offshore Marine Plans (MMO, 2015), there are estimated to be a low occurrence of overlapping foraging ranges (between 2 and 3 foraging ranges) in the vicinity of the VDP1 and LDP1 areas. This estimate is based on information from the combined work of the MMO and JNCC looking at the SPAs in UK waters and the 25 species that breed regularly in UK waters, and is presented on the MMO marine planning portal.

4.6 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 be expected to result in population level changes of marine mammals but it is currently not possible to predict the extent of any such changes (SMRU, 2001).

4.6.1 Cetaceans

The main cetacean species occurring in the area of VDP1 and LDP1 (Quadrants 48 and 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*), white-sided dolphin (*Lagenorhynchus acutus*), bottlenose dolphin (*Tursiops truncatus)* and common dolphin (*Delphinus delphis*) (Reid *et al*., 2003; UKDMAP, 1998) (Table 4.5).

Table 4.5: Marine mammal densities in Quadrants 48 and 49

Species	J	F	M	A	M	J	J	A	S	O	N	D
Harbour porpoise		L	H	L	L	H	H	VH	H	L	M	L
White-beaked dolphin	L		VH	M	L	H	L	L	L	L	H	L
Minke whale						L	L	L	L	L		
Long-finned pilot whale								L				
Bottlenose dolphin								L			L	
White-sided dolphin								L	L			
Common dolphin		L							M			

KEY:

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

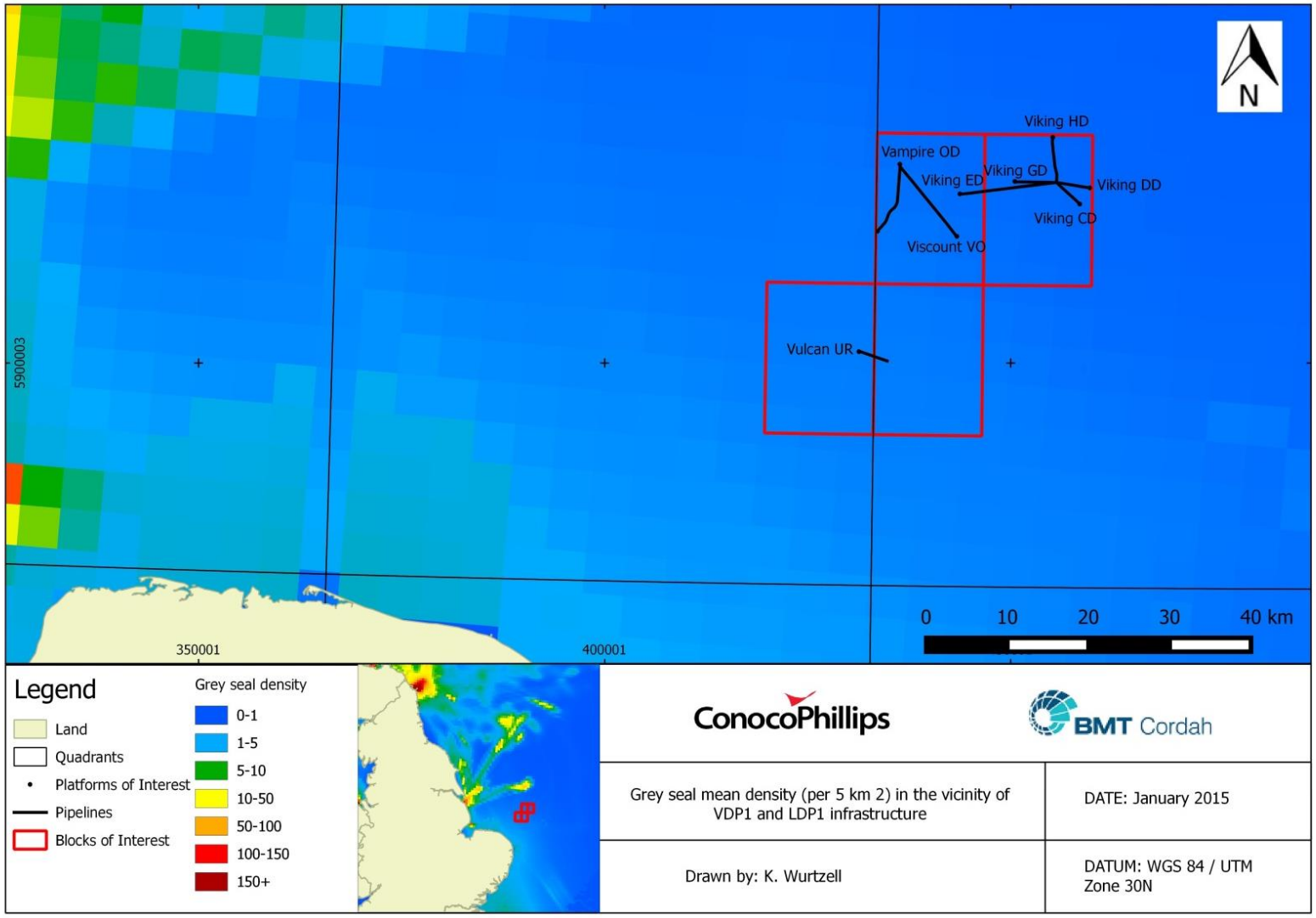
Sightings within Quadrants 48 and 49
Sightings in surrounding Quadrants

Sources: Reid *et al*., 2003; UKDMAP, 1998.

4.6.2 Pinnipeds

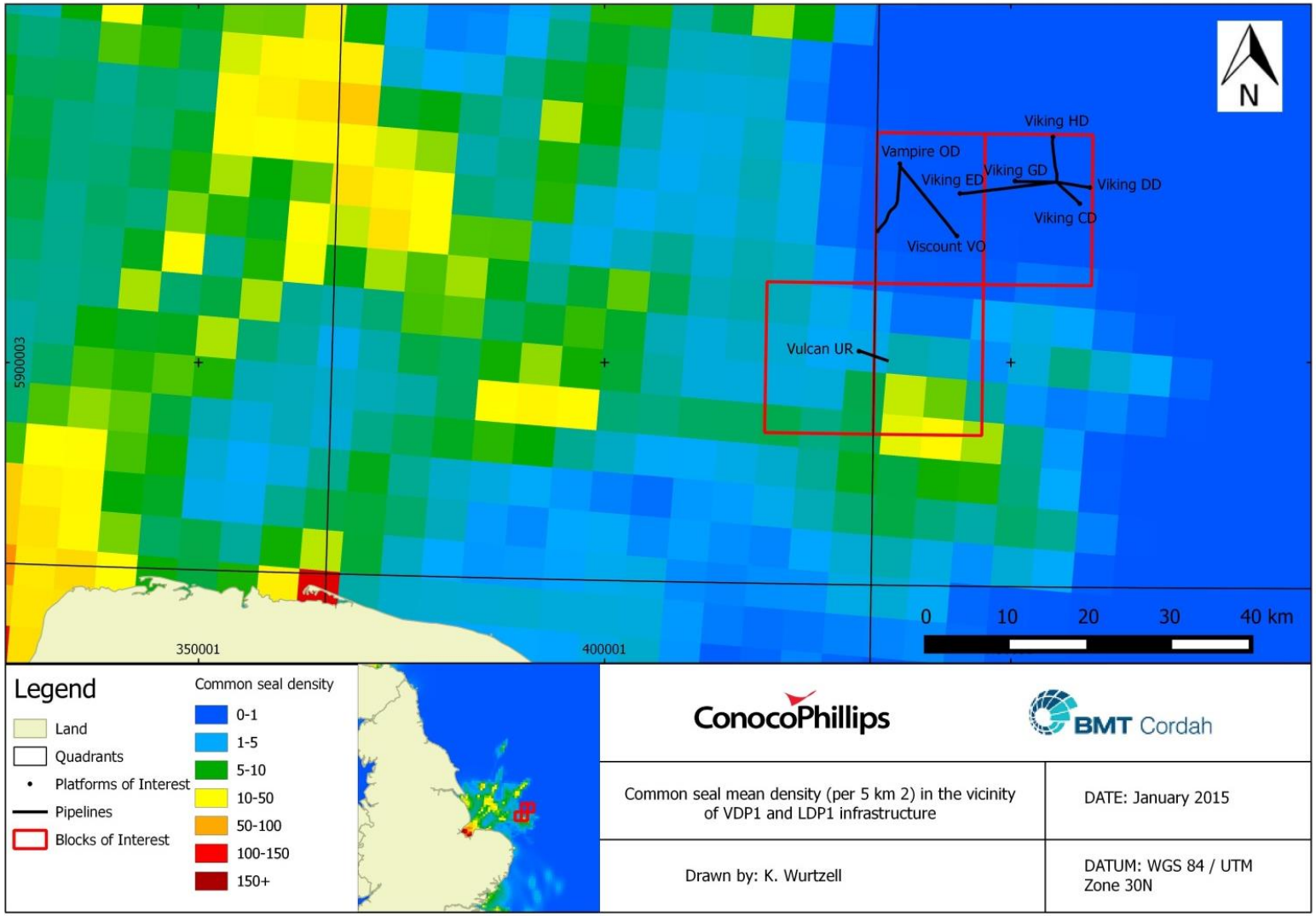
The grey seal and the harbour or common seal, are both resident in UK waters and occur regularly over large parts of the North Sea (SCOS, 2009). Density mapping by Jones *et al*., (2013) indicates a high grey seal usage around the mouth of the Humber River and close to the Donna Nook National Nature Reserve (Natural England, 2014a). Seals may travel past the VDP1 and LDP1 areas towards foraging grounds, but grey seal density around the area to be decommissioned diminishes with distance offshore. In Quadrants 48 and 49, between 0 and 5 grey seals could be present in a 5 x 5 km grid square at any one point in time (Figure 4.14).

Common seals have been observed in high concentrations in The Wash National Nature Reserve which supports one of the largest populations in England (Natural England, 2014b) and are also more likely to be found further offshore in the area to be decommissioned. It is likely that they are travelling to this area from haul-out sites in The Wash to forage for food. In the VDP1 area between 1 and 5 common seals could be present in a 5 x 5 km grid square at any one point in time, however in the LDP1 area this increases to between 1 and 50 common seals per 25 km^2 (Jones *et al*., 2013) (Figure 4.15).



Sources: MMO, 2015; DECC, 2014a; UK Oil and Gas Data, 2014; Jones *et al.*, 2013.

Figure 4.14: Grey seal density in in the vicinity of the VDP1and LDP1 decommissioning area



Sources: MMO, 2015; DECC, 2014a; UK Oil and Gas Data, 2014; Jones *et al.*, 2013.

Figure 4.15: Common seal density in in the vicinity of the VDP1and LDP1 decommissioning area

4.7 Summary of Environmental Characteristics and Sensitivities

Table 4.6 summarises the environmental sensitivities in the sea area surrounding the infrastructure in VDP1 and LDP1. Rows highlighted in grey represent the features or species most likely to be directly impacted from the decommissioning activities.

Table 4.6: Summary of environmental characteristics and sensitivities

Aspect	Months of the Year											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Site overview												
The Viking (VDP1) and LOGGS (LDP1) facilities are located in Quadrants 48 and 49 in the SNS. The structures to be decommissioned are situated within four Blocks (Blocks 48/25, 49/16, 49/17 and 49/21).												
Conservation interests												
Offshore Annex I habitats												
North Norfolk Sandbanks and Saturn Reef SCI	All of the infrastructure included in LDP1 and VDP1 are located within this SCI. The sandbanks typically have fields of sand waves associated with them. The Annex I biogenic reef habitats formed by the polychaete worm (*S. spinulosa*) are also present in the SCI.											
Inner Dowsing, Race Bank and North Ridge SCI	The SCI is located 63 km west of the LDP1 area. The SCI is designated for its sandbanks which are slightly covered by seawater all the time, and for its *S. spinulosa* reef habitats.											
Haisborough, Hammond and Winterton SCI	The SCI is located 26 km south of the LDP1 area. The SCI is designated for sandbanks which are slightly covered by seawater all the time, and for *S. spinulosa* reef habitats.											
Coastal conservation sites												
SACs	There are two inshore SACs located less than 70 km from the LDP1 decommissioning area: • Overstrand Cliffs (57 km SW) • The Wash and North Norfolk Coast (62 km SW)											
SPAs	There are two inshore SPAs located less than 70 km from the LDP1 decommissioning area: • The North Norfolk Coast (65 km SW) • The Outer Thames Estuary (68 km S)											
Coastal and Offshore Annex II species												
Harbour porpoise		L	M	L	L			VH	H	L		
Bottlenose dolphins	No Bottlenose dolphins were recorded in Quadrants 48 and 49.											
Grey seals	Based on density at sea data there could be between 0 - 5 grey seals per 25 km^2.											
Common seals	Based on density at sea data there could be between 0 - 50 common seals per 25 km^2.											
Designated areas												
No designated conservation sites (Marine Coastal Zones) coincide with the VDP1 and LDP1 facilities.												
Plankton												
Plankton in the sea area surrounding the VDP1 and LDP1 areas are likely to be typical for the SNS. Dominant phytoplankton species are dinoflagellates of the genus *Ceratium*, including *C. fusus*, *C. furca* and *C. tripos*. High numbers of the genus *Cheaetoceros* are also present. Dominant species of zooplankton present include small copepods including *Para-Pseudoclanus spp*., and echinoderm larvae. The larger species of copepods, *Calanus helgolandicus* and *Metridia lucens* are also present.												

KEY:

VH	Very high abundance
H	High abundance
M	Moderate abundance
L	Low abundance
ND	No data

Table 4.6 (Continued): Summary of environmental characteristics and sensitivities

Aspect	Months of the Year											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic environment												
Seabed sediments	Sediments in both decommissioning areas comprise fine to coarse sands, often silty and with variable amounts of shell fragments and occasional pebbles and cobbles. The highly dynamic marine environment restricts the silt and clay content to less than 15 %. Chemical analysis of sediment samples found metals and TPH to be within the range of reported background concentrations and below the effects range. The seabed habitat when classified using the EUNIS code is *A5.2: "Sublittoral, clean medium to fine or non-cohesive slightly muddy sands on open coasts, offshore or in estuaries and marine inlets".*											
Benthic fauna	Benthic fauna identified during seabed surveys are typical for this area of the SNS. The shallow-water infaunal assemblage is typically characterised by taxa including polychaetes, bivalve molluscs and amphipods and crustaceans. *S.spinulosa* were identified in several historical survey reports within and adjacent to the areas containing VDP1 and LDP1 infrastructure, however, recent surveys did not observe sections of *S. spinulosa* habitat which would qualify as reef under the JNCC guidance.											
***Fish* – spawning, juvenile and nursery areas (**for the ICES Rectangles 35F1 and 35F2)												
Mackerel	JN	JN	JN	JN	JNS*	JNS*	JNS*	JNS	JN	JN	JN	JN
Herring	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN
Cod	JNS	JNS*	JNS*	JNS	JN	JN	JN	JN	JN	JN	JN	JN
Whiting	JN	JNS	JNS	JNS	JNS	JNS	JN	JN	JN	JN	JN	JN
Plaice	JNS*	JNS*	JNS	JN	JN	JN	JN	JN	JN	JN	JN	JN
Lemon sole	N	N	N	NS	NS	NS	NS	NS	NS	N	N	N
Sole	JN	JN	JNS	JNS*	JNS	JN	JN	JN	JN	JN	JN	JN
Sandeel	NS	NS	N	N	N	N	N	N	N	N	NS	NS
Sprat	JN	JN	JN	JN	JNS*	JNS*	JNS	JNS	JN	JN	JN	JN
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
Horse mackerel	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN	JN
Seabirds *(* denotes median score for blocks containing infrastructure)*												
The most common species of seabird found in these areas of the SNS include: Fulmar, Gannet, Guillemot, Kittiwake, Razorbill, Puffin, Little Auk; as well as numerous species of gull, tern, and skua.												
Seabirds vulnerability	3	2	1	3	3	4	4	3	3	2	2	2
Marine mammals *(* denotes generalised for Quadrants 48 and 49)*												
Harbour porpoise		L	H	L	L			VH	H	L		
White-beaked dolphin	L			M	L				L	L		
White-sided dolphin								L				

KEY:

Fish area	
S	Spawning
S*	Peak spawning
J	Juveniles
N	Nursery

Seabird vulnerability	
1	Very high vulnerability
2	High vulnerability
3	Moderate vulnerability
4	Low vulnerability
ND	No data

Marine mammal sightings	
VH	Very high
H	High
M	Moderate
L	Low
ND	No data

4.8 Socioeconomic Environment

Key socioeconomic characteristics of the area within which VDP1 and LDP1 are located are provided in the following sections.

4.8.1 Commercial fisheries

Moderate to low fishing activity occurs within the vicinity of VDP1 and LDP1.

For management purposes, ICES collates fisheries information for individual rectangles measuring approximately 30 x 30 nm. Table 4.7 and 4.8 provide information on the annual landings within the UK by tonnage and value for the two ICES rectangles containing the VDP1 and LDP1 infrastructure. Figures 4.16 to 4.20 summarise the value, tonnage and annual effort of commercial fishing vessel landings (both UK and foreign vessels) in the North Sea highlighting the main fisheries targeted.

The UK landings from within the two ICES rectangles (35F1 and 35F2) containing the infrastructure to be decommissioned are relatively low, with the exception of the potting in ICES 35F1 (Figures 4.17 and 4.18). However this potting activity is targeted closer to shore and no potting activity is recorded within 20 km of the LDP1 infrastructure within ICES 35F1 (Figure 4.23).

The Dutch beam trawl landings from within ICES rectangle and 35F2 have been in excess of €4,000,000 throughout the period for which data is shown in Figure 4.20. It is interesting to note the relatively high landings were recorded in 2011 and 2012 for dredging. However there are some uncertainties regarding the validity of this data, as experimental dredging for clams and cockles has occurred in this area, though this has now ceased. It is also possible that landings by dredges may have been misreported (Brown and May, 2014).

Vessel Monitoring Satellite (VMS) data indicate the majority of fishing effort is targeted out with the decommissioning area. These data are representative of vessels over 15 m in length, which is the majority of the vessels working in this offshore area.

Within a 50 km radius of the VDP1 and LDP1 infrastructure, fishing vessels are mainly from the Netherlands. These vessels are primarily beam trawlers fishing for demersal species including plaice. However these vessels are moving fishing practices to electric beam trawl gear which requires a clean seabed to operate, and as a result fewer vessels are actually fishing near the current infrastructure to minimise snagging risks to this expensive gear (Brown and May, 2014).

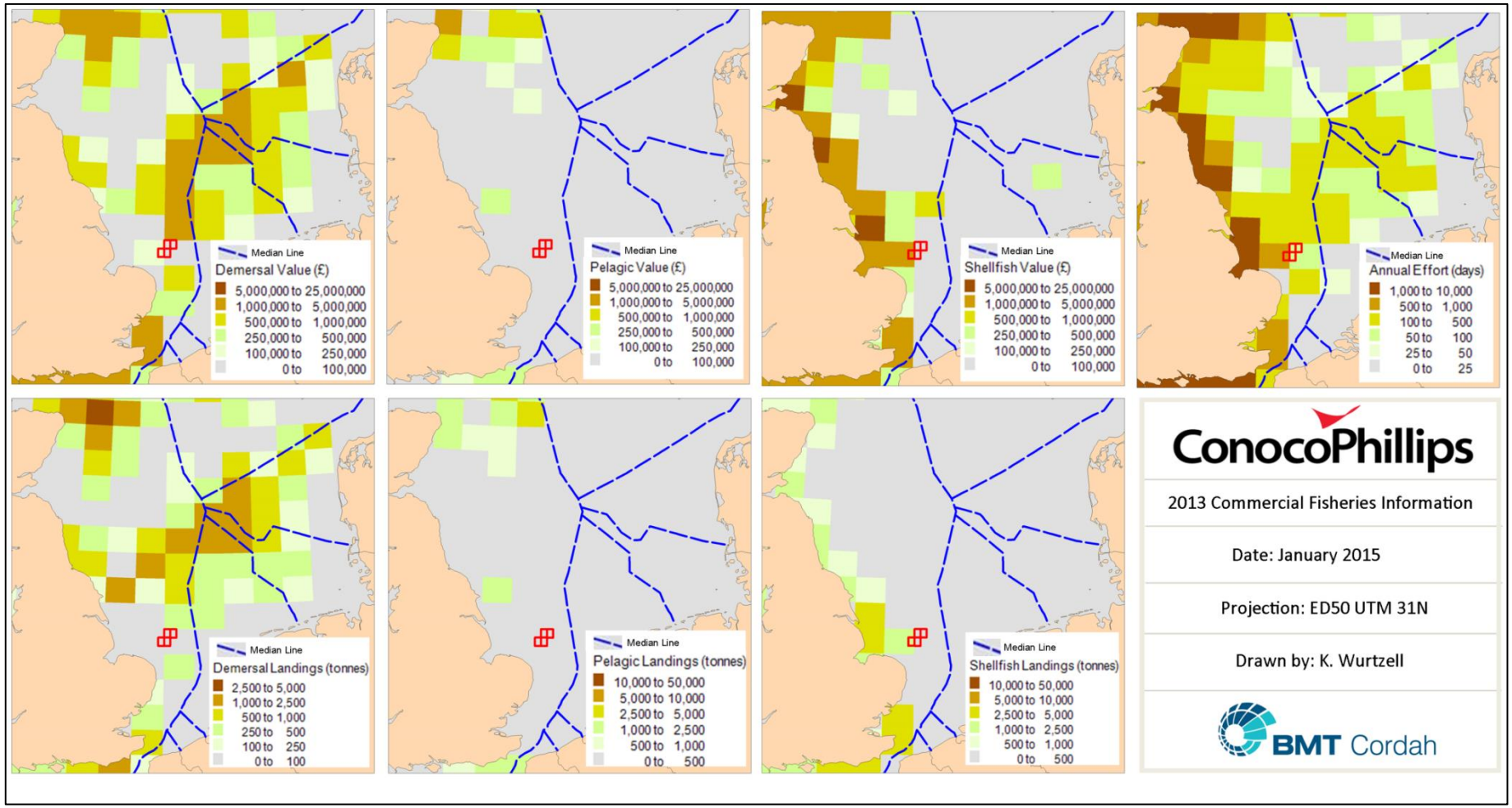
Figures 4.21 to 4.24 summarise the key fishing interests by nationality and gear type within the vicinity of the proposed decommissioning works. This information is based on VMS data supplied by the respective nationalities.

Table 4.7: Annual landings in tonnes for ICES rectangles containing VDP2 and VDP3 infrastructure

ICES Rectangle	35F0	35F1	35F2	36F2
Annual landings in tonnes				
Year	2014	2014	2014	2014
Demersal species	12.0 (Low)	22.2 (Low)	121.3 (Low)	196.5 (Low)
Pelagic species	0.1 (Low)	-	<0.1 (Low)	<0.1 (Low)
Shellfish species	3551.7 (Moderate)	1100.3 (Low)	3.8 (Low)	38.6 (Low)

Table 4.8: Annual landings value in GBPs for ICES rectangles containing VDP2 and VDP3 infrastructure

ICES Rectangle	35F0	35F1	35F2	36F2
Annual landings value in GBP				
Year	2014	2014	2014	2014
Demersal species	28,396.03 (Low)	76,721.05 (Low)	376,389.73 (Low)	323,852.31 (Low)
Pelagic species	161.00 (Low)	-	0.11 (Low)	24.46 (Low)
Shellfish species	2,161,019.62 (Moderate)	1,210,266.90 (Low)	3,276.92 (Low)	107,776.34 (Low)



Sources: Scottish Government, 2014; Crown Estate 2014.

Figure 4.16: Annual commercial fishing landings figures for 2013

	Year									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Beam trawls	£128,236	£392,429	£345,363	£150,536	£17,844	£59,315	£308,878	£134,018	£214,063	£63,847
Bottom otter trawls	£3,510	£11,889	£0	£0	£0	£39,141	£0	£0	£12,885	£13,987
Otter twin trawls	£0	£33,923	£6,097	£0	£0	£0	£0	£0	£0	£0
Nephrops trawls	£0	£0	£0	£0	£25,379	£0	£0	£0	£6,572	£0
Midwater pair trawls	£0	£0	£0	£0	£0	£0	£0	£0	£27,619	£0
Other Methods	£381	£5,181	£1,751	£1,801	£2,555	£0	£2,965	£844	£1,381	£11,894

Source: Brown and May, 2014.

Figure 4.17: UK vessel annual landings from ICES rectangle 35F1

	Year									
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Pots	£791,288	£580,764	£576,250	£599,789	£705,759	£755,939	£342,519	£455,645	£639,048	£851,548
Beam trawls	£43,086	£12,677	£34,222	£52,844	£150,975	£75,920	£3,998	£859	£0	£119
Otter trawls (not specified)	£2,356	£19,344	£7,805	£2,516	£14,334	£18,193	£7,768	£0	£4,944	£16,241
Gillnets	£5,618	£4,696	£0	£0	£0	£4,253	£648	£966	£21	£6,297
Longlines	£0	£4,287	£7,564	£2,428	£0	£3,943	£156	£810	£0	£350
Other Methods	£5,400	£1,650	£300	£36	£0	£545	£7,089	£1,935	£3,872	£165

Source: Brown and May, 2014.

Figure 4.18: UK vessel annual landings from ICES rectangle 35F2

	Year					
	2008	2009	2010	2011	2012	2013
Beam Trawls	€ 548,400	€ 428,600	€ 975,300	€ 1,105,400	€ 615,000	€ 546,100
Midwater Trawls	€ 37,100	€ 0	€ 0	€ 0	€ 0	€ 0
Seine Nets	€ 0	€ 1,000	€ 6,700	€ 0	€ 0	€ 0
Nets	€ 0	€ 0	€ 0	€ 0	€ 700	€ 0

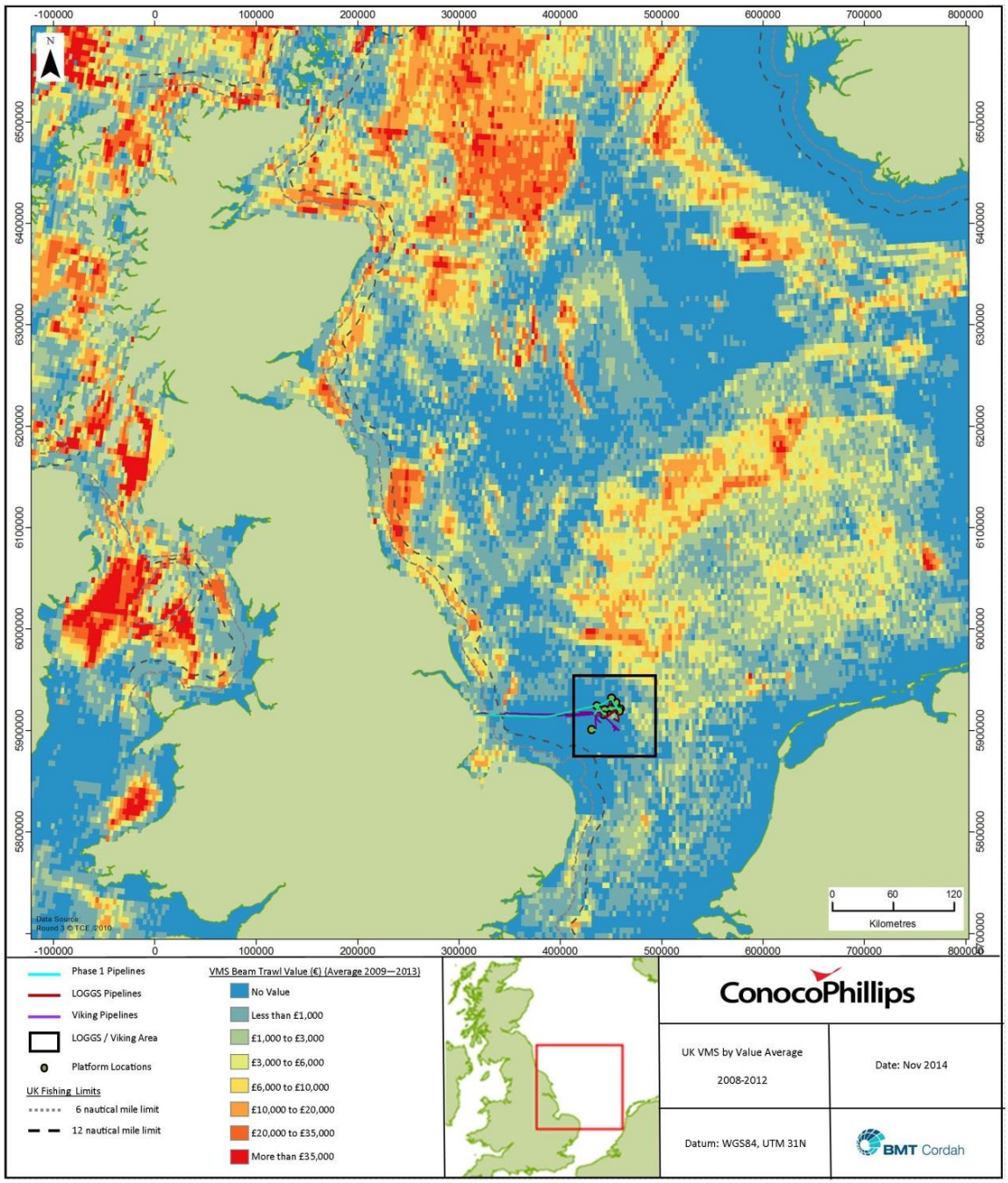
Source: Brown and May, 2014.

Figure 4.19: Dutch vessel annual landings from ICES rectangle 35F1

	Year					
	2008	2009	2010	2011	2012	2013
Beam Trawls	€ 4,857,800	€ 7,160,400	€ 6,010,700	€ 4,713,800	€ 5,214,800	€ 8,706,800
Dredge	€ 0	€ 0	€ 0	€ 2,587,600	€ 4,328,700	€ 63,700
Midwater Trawls	€ 63,800	€ 0	€ 0	€ 107,200	€ 225,300	€ 0
Demersal Trawls	€ 123,300	€ 20,600	€ 0	€ 0	€ 0	€ 0
Other Methods	€ 28,800	€ 5,800	€ 1,300	€ 2,700	€ 41,300	€ 400

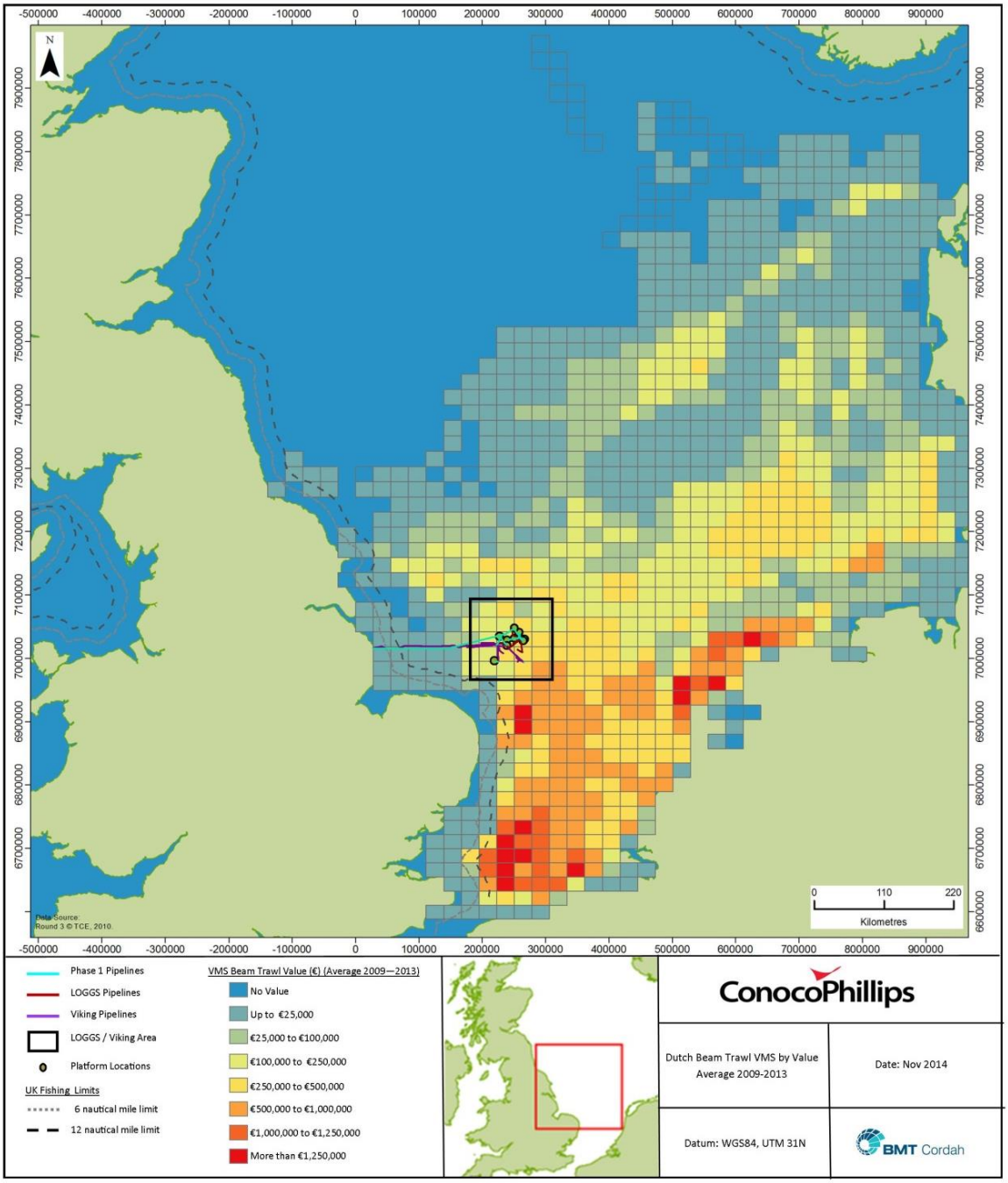
Source: Brown and May, 2014.

Figure 4.20: Dutch vessel annual landings from ICES rectangle 35F2



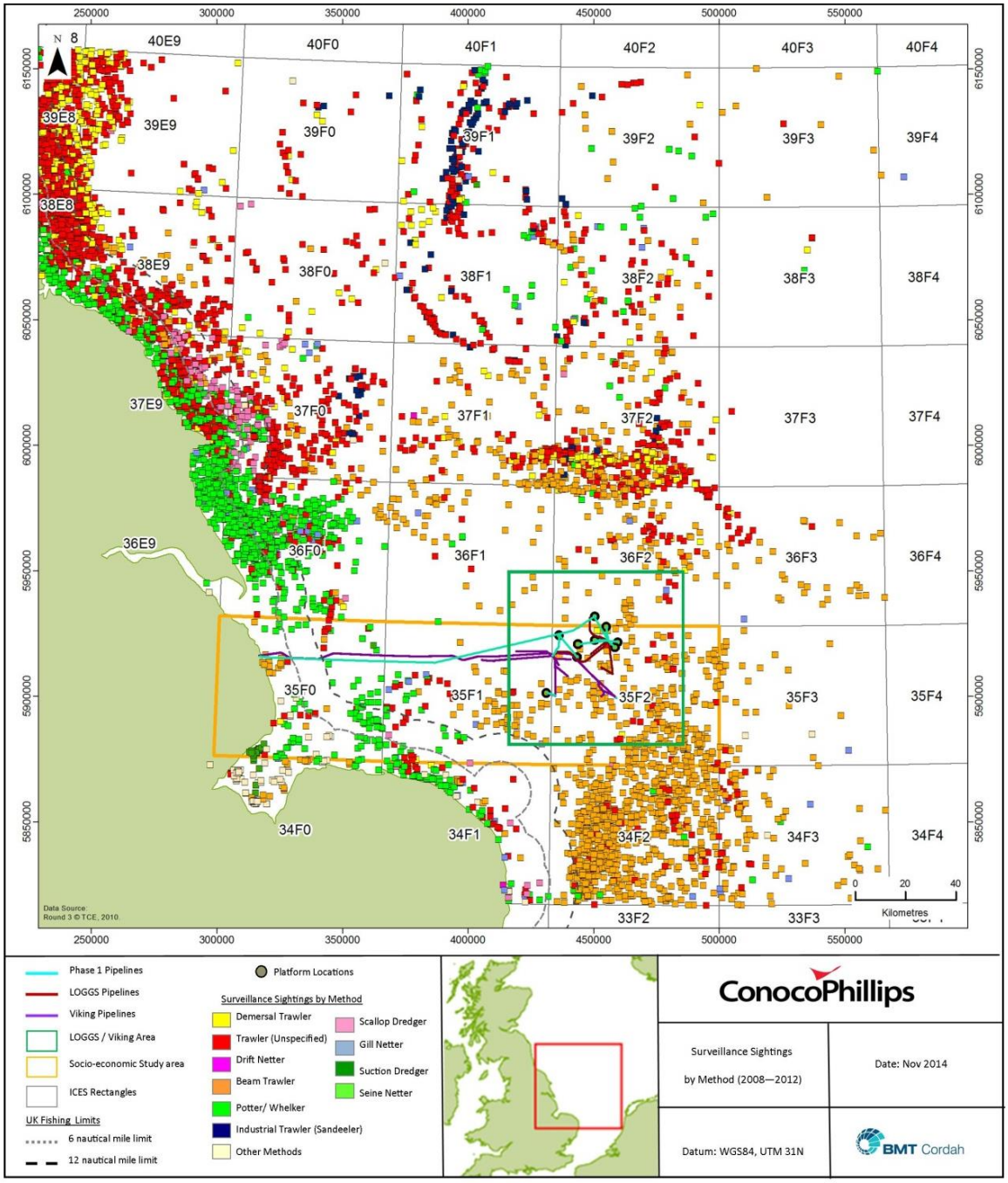
Sources: Brown and May, 2014; Crown Estate 2014.

Figure 4.21: Average fishing value based on UK VMS data



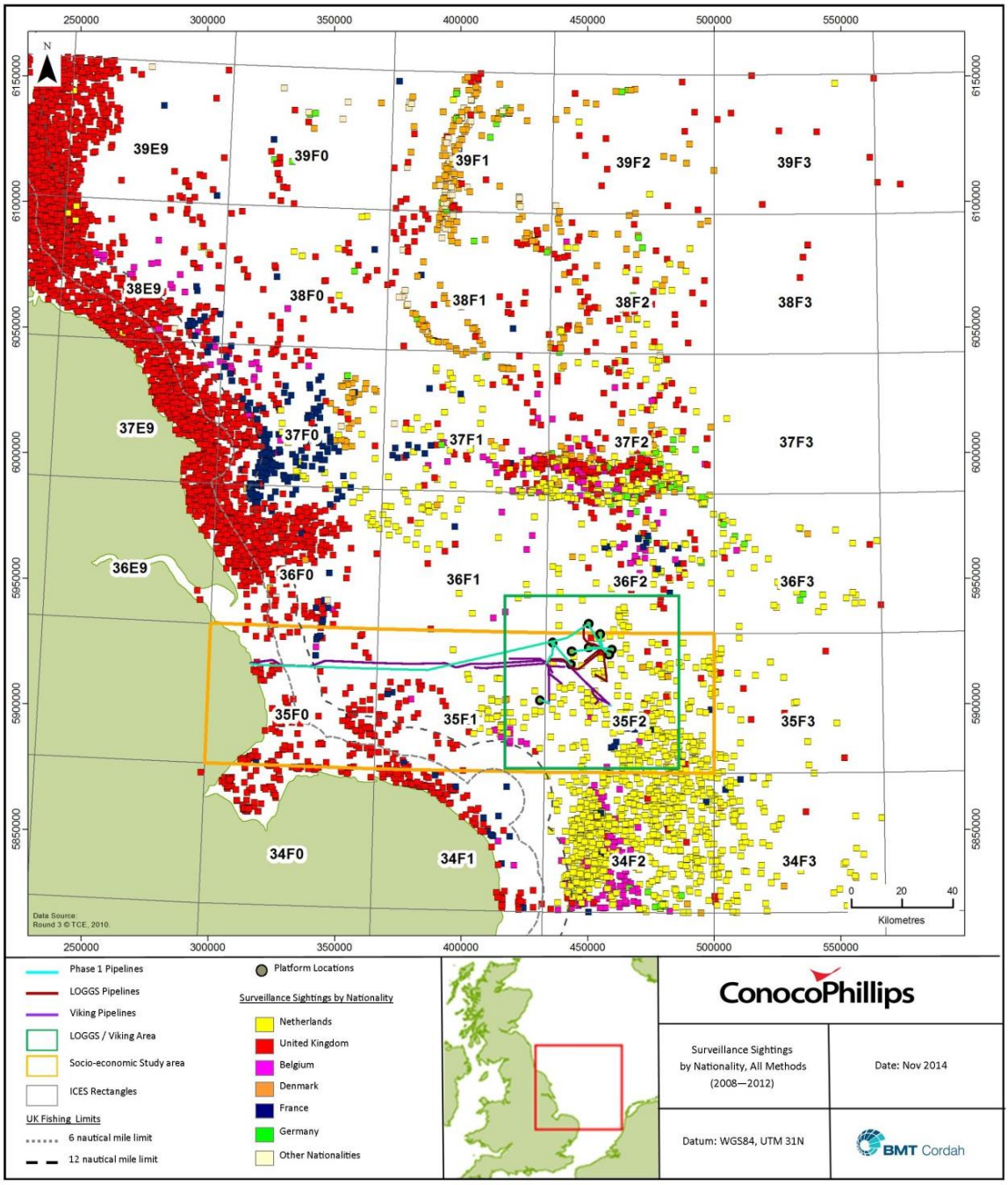
Sources: Brown and May, 2014; Crown Estate 2014.

Figure 4.22: Dutch beam trawl average fishing value



Sources: Brown and May, 2014; Crown Estate 2014.

Figure 4.23: Fishing effort by gear type

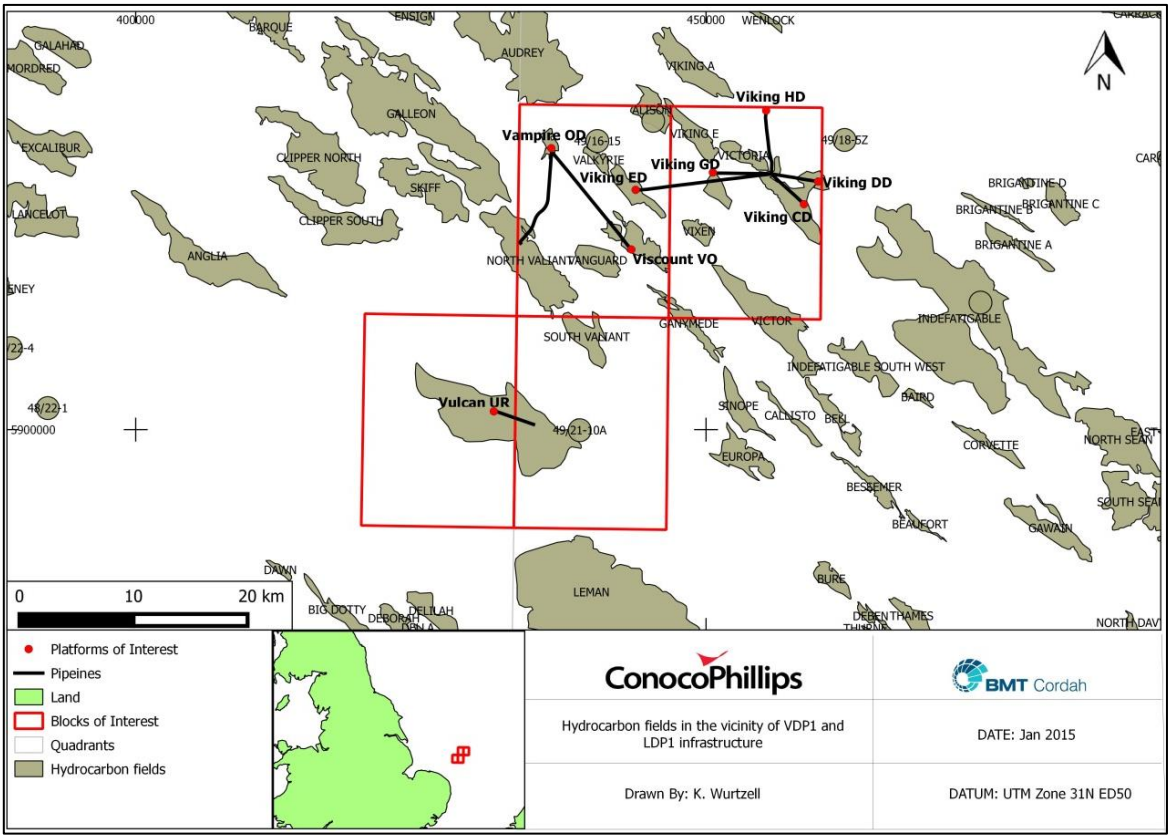


Sources: Brown and May, 2014; Crown Estate 2014.

Figure 4.24: Fishing effort by nationality

4.8.2 Oil and gas industries

The infrastructure included within the scope of VDP1 and LDP1 are located in the SNS gas basin which is currently home to 177 installations, eight of which are currently listed as un-operational (DECC, 2014b). The Indefatigable Field is located 11 km south east of the VDP1 and LDP1 infrastructure (Figure 4.25).



Sources: DECC, 2014a; UK Oil and Gas Data, 2014; Crown Estate, 2014.

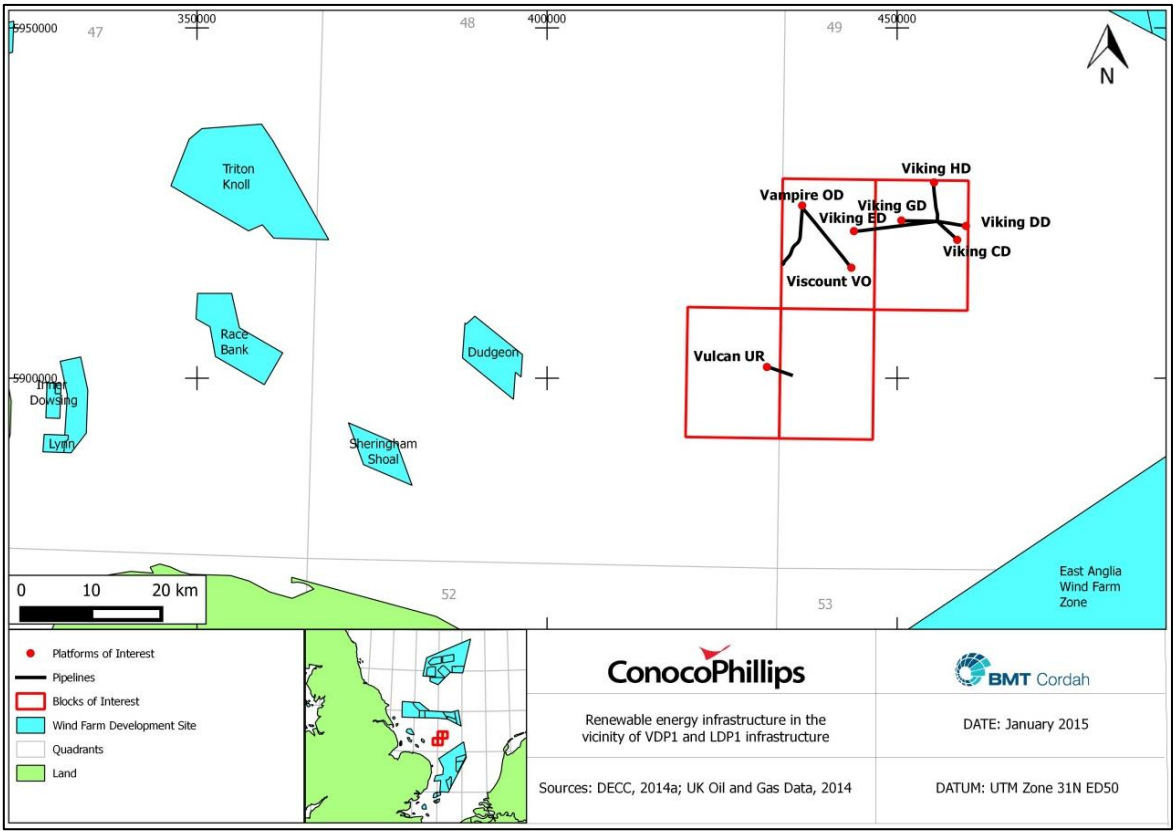
Figure 4.25: Oil fields within the southern North Sea

4.8.3 Offshore renewables

The VDP1 infrastructure is located approximately (at their closest point) 32 km south of the Hornsea Wind farm zone and 42 km NW of the East Anglia Wind farm zone. The LDP1 infrastructure is located approximately 36 km east of the planned Dudgeon wind farm site.

The Development Consent Order for the East Anglia ONE Offshore Wind farm was consented in June 2014. This development has been provided with a grid connection of 1,200 megawatts, construction is anticipated to commence in 2015 (Figure 4.26).

The Dudgeon wind farm site is currently owned by Statoil and construction is planned to commence in 2015 with onshore cable aspects with construction of the offshore foundations expected to commence in 2016. It's anticipated that the wind farm will be fully commissioned by the end of 2017.



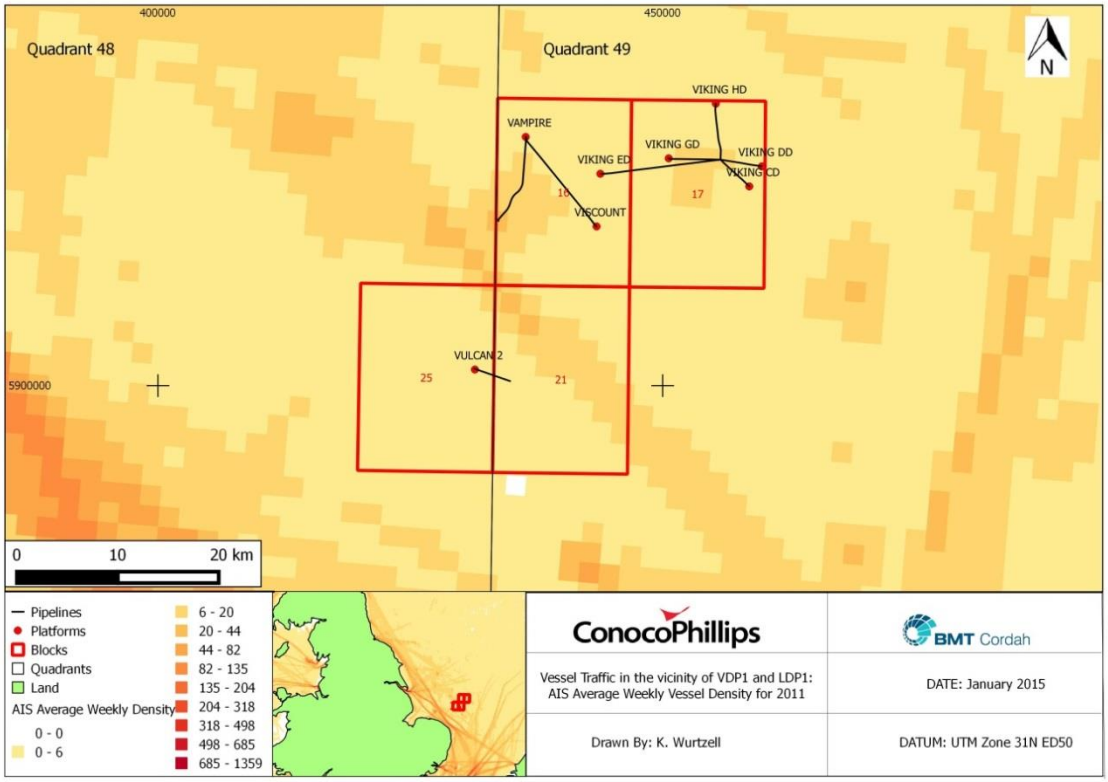
Sources: DECC, 2014a; UK Oil and Gas Data, 2014; Crown Estate, 2014.

Figure 4.26: Offshore wind renewable energy infrastructure within the southern North Sea

4.8.4 Commercial shipping

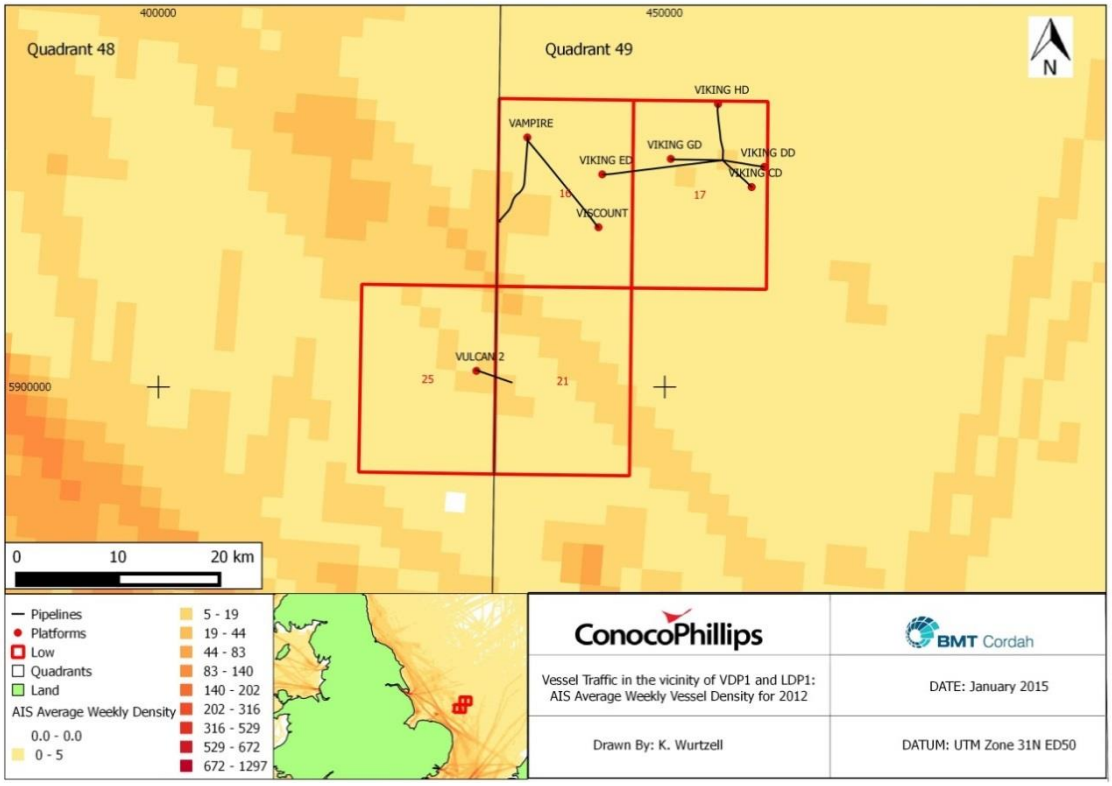
Shipping density in the area of the VDP1 and LDP1 facilities ranges from very low to high (DECC, 2014c). The MMO has made vessel Automated Identification System (AIS) data available for 2011 and 2012. The combined AIS data images for 2011 and 2012 are presented in Figures 4.27 and 4.28. These indicate that there is a shipping route between the Vulcan UR installation and the Vampire VO and Viscount OD installations. There is also a degree of vessel activity in the vicinity of the platforms to be decommissioned; however this is most likely attributed to vessels servicing the platforms. Figures 4.29a to 4.29c indicate the constituting vessel spread associated with the vessel activity presented in Figure 4.28 for 2012 AIS data.

AIS data only provide information on the type of vessel and not what activity it is undertaking. This needs to be considered when looking at vessels such as fishing vessels (Figure 4.29b). This activity could represent transiting to/ from fishing grounds, guard vessel duties or fishing activities.



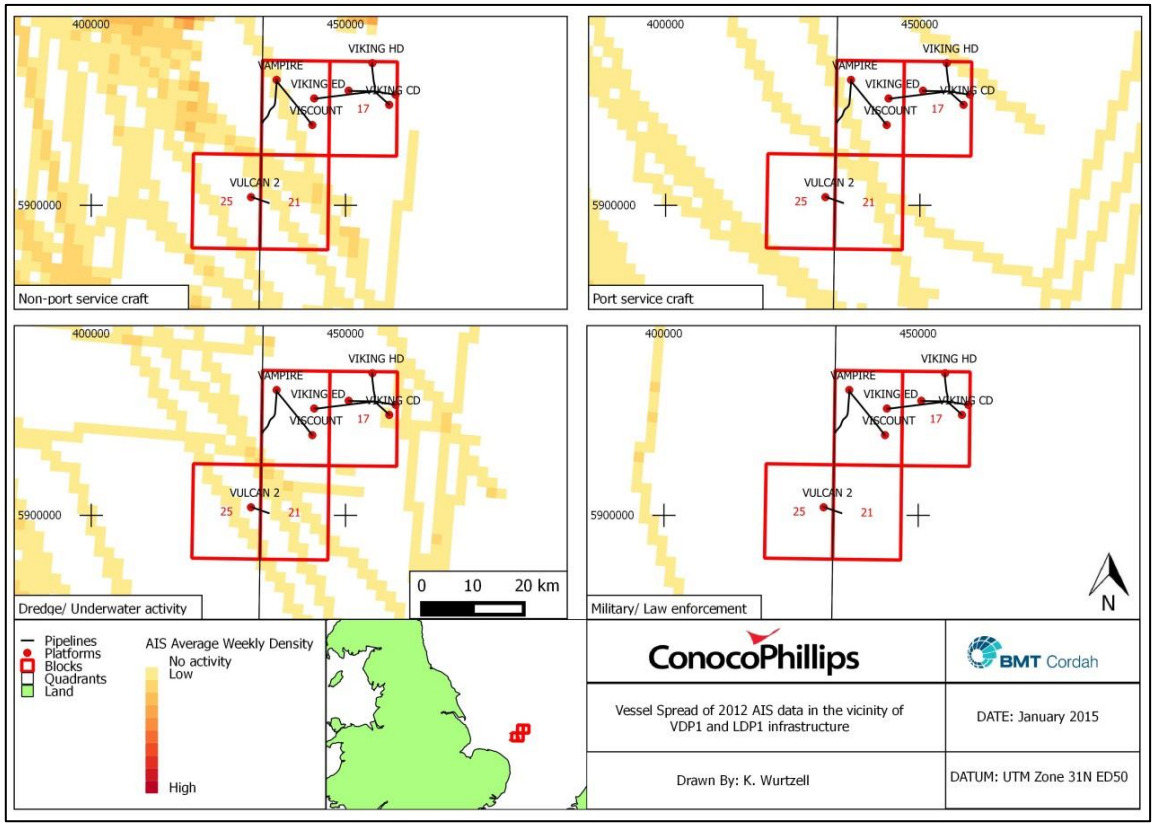
Sources: DECC, 2014a; UK Oil and Gas Data, 2014; MMO, 2014.

Figure 4.27: Summary of the AIS average weekly vessel density for 2011 within the blocks containing VDP1 and LDP1 infrastructure



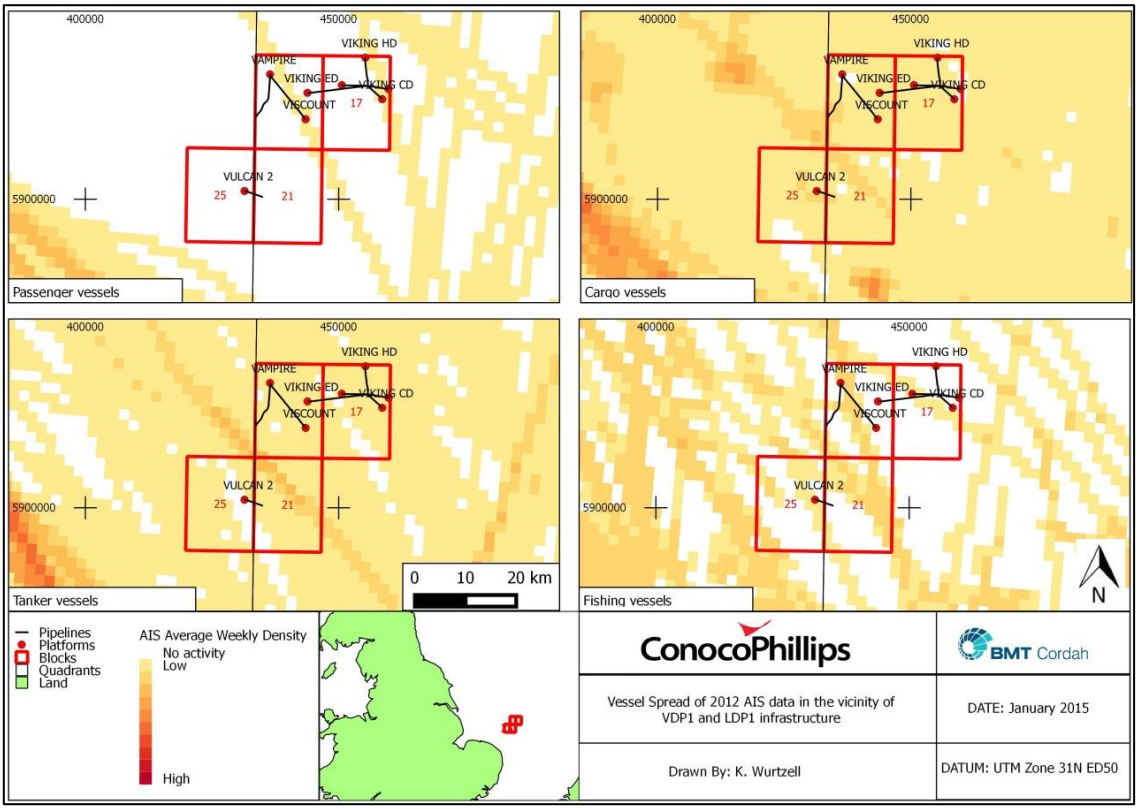
Source: DECC, 2014a; UK Oil and Gas Data, 2014; MMO, 2014.

Figure 4.28: Summary of the AIS average weekly vessel density for 2012 within the blocks containing VDP1 and LDP1 infrastructure



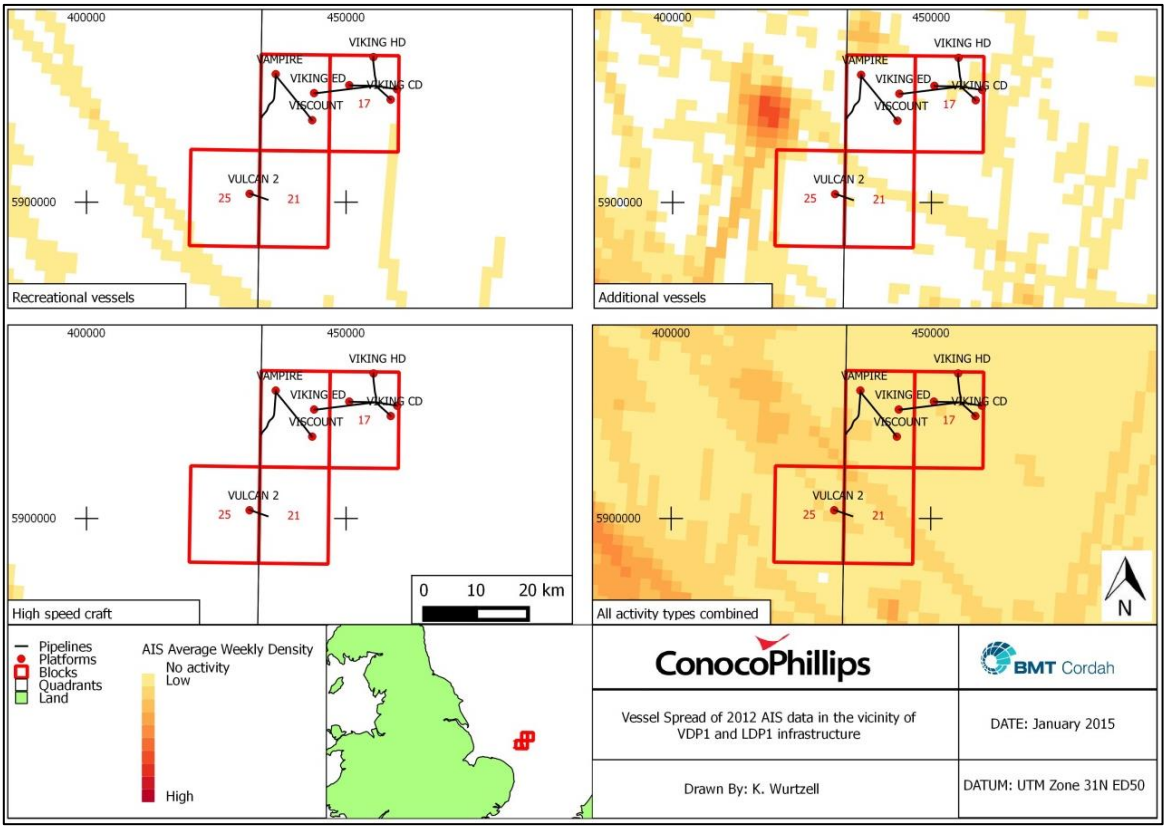
Source: DECC, 2014a; UK Oil and Gas Data, 2014; MMO, 2014.

Figure 4.29a: Vessel spread of the 2012 AIS data within the blocks containing VDP1 and LDP1 infrastructure



Source: DECC, 2014a; UK Oil and Gas Data, 2014; MMO, 2014.

Figure 4.29b: Vessel spread of the 2012 AIS data within the blocks containing VDP1 and LDP1 infrastructure



Source: DECC, 2014a; UK Oil and Gas Data, 2014; MMO, 2014.

Figure 4.29c: Vessel spread of the 2012 AIS data within the blocks containing VDP1 and LDP1 infrastructure

The main contributing factor of high vessel density in these areas is the number of large international ports within the region, and includes the UK ports of:

- Hull (a commercial and passenger port, with ro-ro ferry services to Zeebrugge and Rotterdam);
- Immingham (a commercial container port on the Humber);
- Grimsby (particularly important for commercial fishing landings); and,
- Great Yarmouth (a supply/fabrication base for the offshore oil and gas industry and a ro-ro ferry service to the Netherlands).

A number of shipping route surveys were undertaken in 2006 in support of the ES for the new Viking to LOGGS pipeline (ConocoPhillips, 2008). It was estimated that 1,549 vessels per year pass in the vicinity of the VDP1 and LDP1 areas. This equated to an average of four to five vessels per day. Although the area has a relatively high shipping density, this is not considered significant compared to other locations in the southern North Sea (ConocoPhillips, 2008).

Moderate activity had previously been indicated at the Viscount platform from the vessel traffic survey carried out in 2000 for the ES supporting the installation of the platform (Conoco, 2002). This indicated that there were approximately 2,000 vessels per annum (an average of six vessels per day) passing within close proximity (less than 20 km) to the well locations. The closest vessel traffic routes to the wells were between 4 to 8 km away, with vessel usage at approximately 1,000 vessels per annum. The vessels utilising the area were primarily merchant vessels travelling between Amsterdam and the Forth, and the Dover Strait and the Forth.

Similar vessel densities were observed in the ES for the Valkyrie well extension in 2003. This assessment indicated several shipping lanes in the vicinity of Block 49/16, with approximately 1,000 vessels using these each year. Most of these vessels were large vessels over 40,000 tonnes. There were also about 1,500 supply vessels expected to use the area per year, these were primarily small vessels less than 1,000 tonnes (ConocoPhillips, 2003).

4.8.5 Telecommunications and cabling

The Tampnet telecommunications cable links the UK and Norway and in addition connects five offshore platforms. 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 the infield pipelines from Viking BD to Viking GD (PL0092, PL0066) and Viking ED (PL0091, PL0133). The cable also passes within 200m of the Viking HD platform.

4.8.6 Military activities

The block containing the VDP1 and LDP1 infrastructure are all outside of military exercise or training zones.

4.8.7 Aggregate extractions

There are no aggregate extraction zones within the blocks containing the VDP1 and LDP1 infrastructure, however, the Vampire/ Valkyrie platform sits within a prospecting area held by DEME Building materials UK Limited. Three VDP1 platforms (Viking HD, GD and ED) and two LDP1 platforms (Vampire and Viscount) sit within the East Offshore Marine Plans protective area for marine aggregate resource. This is an area designated to ensure that considerations are given to future extractions of gravels when regulators are asked to consider applications for activities which are taking place in these areas which hold suitable for aggregate and sand deposits. The infrastructure is not within any application areas for aggregate extraction (Crown Estate, 2014; MMO, 2015).

4.8.8 Wrecks

There are five wrecks in the vicinity of the infrastructure to be decommissioned under VDP1 and LDP1. None of the wrecks are designated wrecks however all are classed as dangerous wrecks by the UK Hydrographic Office (SeaZone Wrecks, 2013) (Table 4.9).

Table 4.9: Summary of wrecks present in proximity to infrastructure proposed for decommissioning under VDP1 and LDP1

Wreck name	Type of wreck	Proximity to infrastructure
East Essex (probably)	S Trawler	60 m North of PL0091 and PL0066
Jork	General cargo vessel	890 m West of Viking ED
St Martin	Stand-by safety vessel	1450 m Southeast of Viking ED
Unknown	Trawler	775 m Northeast of Viking CD
Unknown	Unknown	480 m North of Viscount VO

Source: SeaZone Wrecks, 2013.

4.8.9 Sea anglers

Based on data presented by the MMO in the East Inshore and East Offshore Marine Plans there is low to medium boat angling activity within both the VDP1 and LDP1 areas. There is reported to be between 10 and 1,660 people per year carried on angling charter vessels however based on the offshore location of the VDP1 and LDP1 the number is likely to be lower than those areas of similar banding nearer shore. Data in classes has been combined to ensure a minimum of five vessels are recorded in this class, to ensure the data set is anonymised (MMO, 2015).

4.8.10 Carbon capture storage

The Viking CD platform is located over an aquifer which has the potential for carbon capture storage (CCS) as cited in the MMO East Inshore and Offshore Management Plan, while Viking DD and Viking GD are located approximately 800 m east and 300 m west, respectively, from the aquifer (MMO, 2015).

4.9 Summary of the Socioeconomic Characteristics and Sensitivities

Table 4.10 summarises the socioeconomic sensitivities in the area surrounding VDP1 and LDP1.

Table 4.10: Summary of the socioeconomic sensitivities in the decommissioning areas

Aspect	Characteristics
Commercial fishing	
Moderate to low fishing activity occurs within the vicinity of the VDP1 and LDP1 facilities. Netherlands and the UK are the two main nationalities that work in the area. The UK vessel activity is targeted closer inshore and is primarily potting vessels fishing for crab and lobsters. Dutch vessels primarily fish further offshore using beam trawlers fishing for demersal species including plaice. Based on VMS data there is little vessel activity in the immediate vicinity of the infield pipelines.	
Other users	
Shipping activity	Shipping activity in the area of the VDP1 and LDP1 infrastructure ranges from very low to high.
Oil and gas	The nearest non-ConocoPhillips field is the Leman Field and its 33 platforms, located 4 km to the south.
Telecommunications	The Tampnet Telecom cable passes within 200 m Viking HD platform and crosses the Viking GD and Viking ED infield pipelines.
Military activities	No military exercise areas in the blocks containing VDP1 or LDP1 infrastructure.
Aggregate extractions	Aggregate application, option areas are located within the area of LDP1 infrastructure.
Windfarms	There are three windfarms within 45 km of the VDP1 and LDP1 infrastructure.
Wrecks	No designated historical wrecks have been recorded in the area. There are five wrecks classed as dangerous wrecks by the United Kingdom Hydrographic Office (UKHO) in the vicinity of VDP1 and LDP1 infrastructure.
Carbon capture storage (CCS)	The Viking CD is located over an aquifer with the potential for CCS in the southern North Sea, while the Viking DD and GD platforms are located approximately 800 m east and 300 m west, respectively, from the aquifer

5.0 STAKEHOLDER VIEWS

Consultation with stakeholders is an important part of the EIA process because it enables the issues and concerns of the stakeholders to be recorded, addressed and communicated within the ES and, where applicable, acted upon during the subsequent planning.

5.1 Initial Consultation

ConocoPhillips has held initial meetings and/or dialogue with DECC, Environment Agency (EA), JNCC, Scottish Fishermen's Federation (SFF), Northern Irish Fish Producers' Organisation (NIFPO), Anglo North Irish Fish Producers Organisation (ANIFPO), National Federation of Fishermen's Organisations (NFFO) and VisNed (Association of Dutch Demersal Fishers) on the proposed decommissioning strategy.

Table 5.1 provides a summary of the key issues raised during the consultation process and ConocoPhillips responses to these issues.

5.2 Future Consultation

The formal consultation process will begin with the submission of the consultation draft for the Decommissioning Programmes. The consultation process will include the Decommissioning Programmes being placed on a ConocoPhillips website. In addition a copy of the Decommissioning Programmes will be available at the ConocoPhillips Aberdeen office for inspection by members of the public. As well as making the programmes publicly available, copies will be sent to the following statutory consultees for comment:

- SFF
- NFFO
- NIFPO
- ANIFPO
- Global Marine Systems Ltd (GMS)
- DECC
- Any other stakeholder as directed by DECC.

The public consultation period will last approximately 30 days, at the end of which ConocoPhillips will be notified of the nature of any objections to the proposals.

Table 5.1: Summary of meetings and key issues raised with regulatory agencies and stakeholders during early discussions

Stakeholder	Meetings/ Focus	ConocoPhillips Related Activities and Responses
DECC	• Meeting 8th December 2011 Infrastructure overview including cessation dates, decommissioning principles and strategic options, potential medium-term decommissioning activities and DECC/ ConocoPhillips engagement plan. • Meeting 3rd December 2012 Overview of the scope of the SNS decommissioning programme, associated Infrastructure and method evaluations, medium-term decommissioning activities and decommissioning plans (documentation and structure). • Meeting 27th February 2013 Overview of field performance and production cessation timings for the SNS and cessation notices in the ConocoPhillips asset management process. • Meeting 19th March 2013 Overview of the scope of the pre-decommissioning baseline environmental survey for the VDP1 and LDP1 decommissioning activities. • Meeting 30th September 2013 Update on the approach to cessation of production within the SNS and the decommissioning programme. • Meeting 28th January 2014 Progress meeting to provide a summary of the SNS well abandonment campaign and activities. A decommissioning programme update was also requested from the Environment Management Team to address the following: environmental surveying for decommissioning; an update on proposed pipeline cleaning; and an update on decommissioning plan submission. • Meeting 29th January 2014 Update on the cessation of production programme.	• Scope of the pre-decommissioning baseline environmental survey for the VDP1 and LDP1 decommissioning activities finalised and commissioned. • Provided copies of the pre-decommissioning environmental baseline survey. • An additional meeting was scheduled with the DECC Environmental Management Team 6th November 2014 to present the southern North Sea future outlook and the proposed scope of an additional SNS pre-decommissioning baseline environmental survey. • 20th November 2014 DECC confirmed they have no objections to the proposed survey scope. ConocoPhillips commenced preparatory work to commission the survey.

Table 5.1 (continued): Summary of meetings and key issues raised with regulatory agencies and stakeholders during early discussions

Stakeholder	Meetings/ Focus	ConocoPhillips' Related Activities/ Responses
DECC	• Meeting 28th February 2014 Progress update on medium-term decommissioning plan, environmental studies including results to-date, submissions/and approvals schedule. A detailed overview of the results of the pre-decommissioning baseline environmental survey for the VDP1 and LDP1 decommissioning activities was presented. • Meeting 4th April 2014 Meeting to provide an update on pipeline flushing and the associated permitting requirements. • Meeting 8th May 2014 Progress update on medium-term decommissioning plan, environmental studies including results to-date, submissions/and approvals schedule. • Meeting 23rd July 2014 Overview of the decommissioning programme, status of current well P&A programme, environmental studies and stakeholder engagement. • Meeting 31st October 2014 Overview of the draft VDP1 and LDP1 Comparative Assessment, Southern North Sea future outlook and the proposed scope of an additional SNS pre-decommissioning baseline environmental survey. • Meeting 6th November 2014 Presentation of the Southern North Sea future outlook and proposed scope of an additional SNS pre-decommissioning baseline environmental survey. • Meeting 5th December 2014 Review and agreement on DECCs comments on the pre-draft of VDP1 and the Comparative Assessment. Agreement gained regarding all comments. • Meeting 29th January 2015 Review and agreement on DECCs comments on the draft of VDP1, pre-draft of LDP1 and the Comparative Assessment.	• DECC confirmed that there were no objections to the scope of the proposed additional SNS pre-decommissioning baseline environmental survey.

Table 5.1 (continued): Summary of meetings and key issues raised with regulatory agencies and stakeholders during early discussions

Stakeholder	Meetings/ Focus	ConocoPhillips' Related Activities/ Responses
JNCC	• Meeting 20th November 2014 ConocoPhillips presented an overview of the scope of the VDP1 and LDP1 decommissioning activities and potential environmental impacts.	

Fisheries organisations	Consultation letter 5th November 2014
	Letter introducing the scope and schedule of VDP1 and LDP1
	• Consultation meetings on the scope of VDP1 and LDP1 prior to statutory consultation scheduled W/C 26th January 2015.
	  • VisNed (Netherlands)
	  • NFFO (UK)
	  • SFF (Scotland)
	  • NIFPO & ANIFPO (Ireland)
	
	NFFO
	Meeting 28th January 2015
	Consultation meeting to build upon the consultation letter previously issued. Primary focus of the consultation meeting:
	• Advise of ConocoPhillips' intentions and to outline plan for managing marine activities;
	• Confirm ConocoPhillips understand the fishing activity in the area and its importance;
	• Communicate current project schedules and establish communication channels ahead of commencement of statutory consultation.
	• Allow ConocoPhillips to better understand any concerns NFFO may have regards the proposed activities.
		• Following discussions, ConocoPhillips and the NFFO, NFFO have advised SFF that a meeting has occurred and on that basis a meeting with the SFF has not been scheduled.
		
		• NFFO requested that, as far as possible, it would be helpful to their membership if designated work areas could be used during decommissioning works, with designated transit routes to/from the work areas for contracted vessels.
		• NFFO did not raise any objections to the proposed decommissioning activities.

Table 5.1 (continued): Summary of meetings and key issues raised with regulatory agencies and stakeholders during early discussions

Stakeholder	Meetings/ Focus	ConocoPhillips' Related Activities/ Responses
Fisheries organisations	**VisNed** Meeting 18th February 2015 Initial consultation meeting. Primary focus of the consultation meeting: • Advise of ConocoPhillips' intentions and to outline plan for managing marine activities; • Confirm ConocoPhillips understand the fishing activity in the area and its importance; • Communicate current project schedules and establish communication channels ahead of commencement of statutory consultation. • Allow ConocoPhillips to better understand any concerns VisNed may have regards the proposed activities.	• There was agreement on a bias against rock-placement, as this has the potential to create local effects resulting in increased scour and pipeline exposure, and also has implications for fishing gear. In cases where it is necessary for rock-placement, VisNed suggested that smaller-sized graded rock would be preferable. • VisNed suggested that the historic locations of the platforms be retained in electronic charts in some form, to cater for the possibility that seabed movements may uncover piles/conductors previously cut at 3m below the seabed. • VisNed did not raise any objections to the proposed decommissioning activities.
	ANIFPO Meeting 11th February 2015 Initial consultation meeting. Primary focus of the consultation meeting: • Advise of ConocoPhillips' intentions and to outline plan for managing marine activities; • Confirm ConocoPhillips understand the fishing activity in the area and its importance; • Communicate current project schedules and establish communication channels ahead of commencement of statutory consultation. • Allow ConocoPhillips to better understand any concerns ANIFPO may have regards the proposed activities.	• A general preference highlighted for avoiding seabed disruption, though it was recognised that some disruption is inevitable near the platform locations, which ConocoPhillips is obliged to remove, with corresponding pipeline-cutting needs. • ANIFPO did not raise any objections to the proposed decommissioning activities.

Table 5.1 (continued): Summary of meetings and key issues raised with regulatory agencies and stakeholders during early discussions

Stakeholder	Meetings/ Focus	ConocoPhillips' Related Activities/ Responses
Fisheries organisations	**NIFPO** Meeting 11th February 2015 Initial consultation meeting. Primary focus of the consultation meeting: • Advise of ConocoPhillips' intentions and to outline plan for managing marine activities; • Confirm ConocoPhillips understand the fishing activity in the area and its importance; • Communicate current project schedules and establish communication channels ahead of commencement of statutory consultation. • Allow ConocoPhillips to better understand any concerns NIFPO may have regards the proposed activities.	• A general preference highlighted for avoiding seabed disruption, though it was recognised that some disruption is inevitable near the platform locations, which ConocoPhillips is obliged to remove, with corresponding pipeline-cutting needs. • NIFPO did not raise any objections to the proposed decommissioning activities.
Environment Agency	• Telephone Conversation 8th January 2015 • ConocoPhillips commenced dialogue with the International Waste Shipments Team regarding the scope of VDP1 and LDP1 and the location of the disposal yards who have submitted commercial bids for the dismantlement and disposal of the infrastructure. • Shown decommissioning programme presentation 25th February 2015.	

6.0 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 directly from planned and unplanned activities associated with the VDP1 and LDP1 activities.

The activities associated with VDP1 and LDP1 have the potential to cause environmental impact in several different ways, including physical disturbance of the seabed, emissions of gases to the atmosphere and the generation of wastes for disposal onshore. These effects could arise as a result of the operations or as consequences of the following aspects of the decommissioning programmes:

- Full removal of topsides and jackets;
- Decommissioning the pipelines *in situ*;
- Decommissioning the mattresses/ grout bags *in situ*; and
- Full removal of LOGGS T-piece.

An assessment of the significance of the risks to any environmental and societal compartment as a result of the operations was undertaken. The assessment looked at both planned operations and unplanned, accidental events.

Both site specific and cumulative impacts were assessed and discussed where appropriate.

6.1 Risk Assessment Methodology

The purpose of the risk assessment is to identify those potential impacts and risks that may be significant in terms of the threat that they pose to particular environmental receptors, the need for measures to manage the risk in line with industry best practice and the requirement to address concerns or issues raised by stakeholders during the consultation for this ES.

In this section of the ES, the scope of the risk assessment is confined entirely to the VDP1 and LDP1 activities. Tables 6.6 to 6.9 show the outcome of this assessment; and Sections 7 to 12 provide a more detailed evaluation of those impacts and risks that were assessed to be significant. Appendix C provides a justification for those risks that were deemed to present a low risk.

Environmental and Societal Risk Assessments for the environmental and societal resources/ concerns, listed in Table 6.1, were undertaken for all of the VDP1 and LDP1 decommissioning options.

Table 6.1: Listing of environmental and societal resources/ concerns

Physical and Chemical	Biological	Societal
• Sediment structure • Seabed integrity/ physical change • Water quality • Land • Freshwater	• Sediment biology (benthos) • Water column (plankton) • Finfish and shellfish • Seabirds • Ecosystem integrity • Conservation sites • Terrestrial flora and fauna	• Commercial fishing • Shipping • Government or institutional users (e.g., Ministry of Defence (MoD)) • Other commercial users • Recreational users • Onshore communities (resources)

These assessments were undertaken using the following method:

1. Each decommissioning option was broken into its component activities/ operations and end points (e.g., rock-placement, cutting of pipeline sections, excavation of buried pipeline, and waste in landfill).
2. Receptors at risk (elements of society or the environment) were identified from the potential operational impacts and end-point impacts:
   - Environment (physical, chemical and biological):
     i. Marine environmental impacts/ risks, including operational and accidental/ unplanned impacts/ risks.
     ii. Onshore environmental impacts/ risks, including operational and accidental/ unplanned impacts/ risks.
   - Societal:
     i. Risk to other users of the sea (i.e., fisheries and non-project shipping, including end-point risks from the long-term presence of the pipeline, as appropriate).
     ii. Risk to those on land (i.e. onshore transport, quayside lifting operations, waste management, recycling and disposal).
3. The significance of the potential environmental impacts and risks were assessed according to pre-defined criteria. These criteria recognise the likely effectiveness of planned mitigation measures to minimise or eliminate potential impacts/ risks.
4. Assessments were undertaken to determine what level of impacts/ risks the component activity/ operation could pose to the different groups of environmental or societal receptors. The following Scoring Criteria and Risk Matrix were applied to complete the worksheets:
   - ConocoPhillips Consequence Severity Description (Table 6.2), and
   - ConocoPhillips Likelihood Matrix (Table 6.3).
5. The overall risk for a particular activity was determined by the ConocoPhillips Risk Matrix and Risk Categories (Tables 6.4a and 6.4b).

Table 6.2: ConocoPhillips consequence/ severity descriptions

	Consequence – Severity Description (most severe down to least severe)			
Category	**Socio-Cultural Economic Impact**	**Biodiversity Impact**	**Environmental Impact (Remediation Costs)**	**Negative Public Image Exposure**
5	• Permanent loss of access or use of area with permanent reduction in associated community; • Major economic impact to surrounding community; • Irrevocable loss of culture resources; • Scale typically widespread (national or greater level).	**Very High**: • Catastrophic loss of natural resources or biodiversity typically over a widespread area, with permanent or long-term consequences; and/ or • Irrevocable loss of regionally unique habitat, legally designated conservation site or intact ecosystems. • No mitigation possible.	> $10,000,000	International Coverage
4	• Permanent partial restriction on access or use, or use, or total restriction >10 years in duration; • Temporary reduction in quality of life > 10 years duration; • Harm to cultural resources requiring major mitigation; • Scale typically regional to national level.	**High**: • Persistent environmental degradation within and beyond the project area, typically with prospects of short-to medium term recovery if the cause of the impact is removed or by natural abatement processes and/ or • Serious loss (>50%) of unique habitat or legally designated conservation site or intact ecosystems within area of study. • Mitigation only possible through prolonged and resource intensive effort (>50 years).	$1,000,000 to $10,000,000	National Coverage
3	• Temporary restriction <10 years in duration with a moderate reduction in usage levels or quality of life; • Harm to cultural resources recoverable through moderate mitigation efforts; • Scale typically local to regional level.	**Medium**: • Persistent environmental degradation within and close to the project area, localised within defined areas, typically with prospects of rapid recovery if cause of the impact is removed or by natural abatement processes and/ or • Temporary, but reversible loss (>25 to 50%) of unique habitat or legally designated conservation site or intact ecosystems within area of study. • Moderate mitigation efforts required (>1 to 50 years).	$100,000 to $1,000,000	Regional Coverage
2	• Brief restriction <5 years in duration with a minor reduction in usage levels or quality of life; • Minor harm to cultural resources that is recoverable through minor mitigation efforts; • Scale typically localised.	**Low**: • Temporary environmental degradation, typically within and close to project area, with good prospects of short-term recovery; and/ or • Brief, but reversible loss (>10 to 25%) of unique habitat or legally designated conservation site or intact ecosystems within area of study. • Minor mitigation efforts required (<1 year).	$10,000 to $ 100,000	Local Coverage
1	• Restrictions on access without loss of resources; • Temporary but fully reversible impacts on quality of life; • Minor impact on cultural resources; • Typically transient and highly localised.	**Negligible**: • Highly transitory or highly localised environmental degradation typically contained within the project area and noticeable/ measurable against background only within or in very close proximity to the project area; and/ or • Some minor loss (<10%) of unique habitat or legally designated conservation site or intact ecosystems within area of study. • Naturally and completely reversible.	$ 0 to $10,000	No Outside Coverage

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Table 6.3: ConocoPhillips likelihood matrix

Likelihood (most likely down to least likely)			
Category	**One word descriptor**	**Description**	**Quantitative Range per Year[1]**
5	**Frequent**	• Likely to occur several times a year. • Very high likelihood or level of uncertainty.	$>10^{-1}$
4	**Probable**	• Expected to occur at least once in 10 years. • High likelihood or level of uncertainty.	10^{-3} to 10^{-1}
3	**Rare**	• Occurrence considered rare. • Moderate likelihood or level of uncertainty.	10^{-4} to 10^{-3}
2	**Remote**	• Not expected nor anticipated to occur. • Low likelihood or level of uncertainty.	10^{-6} to 10^{-4}
1	**Improbable**	• Virtually improbable and unrealistic. • Very low likelihood or level of uncertainty.	$<10^{-6}$

Table 6.4a: ConocoPhillips risk matrix

Risk Matrix						
Likelihood	5	II 5	II 10	III 15	IV 20	IV 25
	4	I 4	II 8	III 12	III 16	IV 20
	3	I 3	II 6	II 9	III 12	III 15
	2	I 2	I 4	II 6	II 8	II 10
	1	I 1	I 2	I 3	I 4	II 5
		1	2	3	4	5
		Consequence Category *				

Note: * Biodiversity and/or socioeconomic considerations take precedence: for all other factors, the worst case score is assumed from the severity descriptions.

Table 6.4b: ConocoPhillips risk categories

Score	Risk	Risk Categories
IV: 17-25	**High**	**High Risk.** Manage risk utilising prevention and/ or mitigation **with highest priority**. Promote issue to appropriate management level with commensurate risk assessment detail.
III: 12-16	**Significant**	**Significant Risk.** Manage risk utilising prevention and/ or mitigation **with priority**. Promote issue to appropriate management level a with commensurate risk assessment detail.
II: 5-10	**Medium**	**Medium Risk** with controls verified. No mitigation required where controls can be verified as functional.
I: 1-4	**Low**	**Low Risk.** No mitigation required.

6.2 Risk Assessment Findings

The summary of the risk assessment is shown in Table 6.5, while detailed assessment is presented in Tables 6.6 to 6.9. The left-hand column of the detailed tables identifies the aspects of the VDP1 and LDP1 that may cause or have the potential to cause impacts to sensitive receptors. These environmental aspects (BSI, 2004) include routine, abnormal and emergency events during the lifetime of the decommissioning project. The remaining columns of the tables identify the potential physical, chemical, biological and societal receptors. The last two right-hand columns of the tables present the overall assessed risk category and the sections of the report that give a detailed justification of the assessment made.

Taking the effects of planned mitigation into account, there were no high environmental risks identified during the assessment. However, the risk assessment identified two activities associated with the VDP1 and LDP1 as having the potential to be of significant risk and several activities to be of medium risk, which are assessed further in Sections 7 to 12:

- Energy use and atmospheric emissions (Section 7);
- Underwater noise (Section 8);
- Seabed impact (Section 9);
- Societal impact (Section 10);
- Discharges to sea (Section 11);
- Accidental hydrocarbon release (Section 12).

These assessments resulted in the completion of risk assessment worksheets to address any general activities associated with decommissioning activities, and specific activities associated with the single lift of topsides, single lift of jackets, decommissioning of pipelines and of mattresses *in situ* with minimal intervention. The worksheet results are presented in the two tables divided into VDP1 (Tables 6.6 and 6.7) and LDP1 (Tables 6.8 and 6.9) activities.

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

Table 6.5: Summary of the total number of risks for the VDP1 and LDP1 risk assessment

Decommissioning Activities	Risk Categories							
	I - Low		II - Medium		III - Significant		IV - High	
	Planned operations	Unplanned operations	Planned operations	Unplanned operations	Planned operations	Unplanned operations	Planned operations	Unplanned operations
VDP1								
General decommissioning activities	6	1	4	1	0	0	0	0
Full removal of topsides and jackets	7	2	2	0	0	0	0	0
Decommissioning pipelines *in situ*	2	0	3	0	1	0	0	0
Decommissioning mattresses *in situ*	0	0	0	0	1	0	0	0
LDP1								
General decommissioning activities	6	1	4	1	0	0	0	0
Full removal of topsides and jackets	7	2	2	0	0	0	0	0
Decommissioning pipelines *in situ*	2	0	3	0	1	0	0	0
Decommissioning mattresses *in situ*	0	0	0	0	1	0	0	0
Full removal of LOGGS T-piece	3	1	0	0	0	0	0	0

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Table 6.6: Activities associated with VDP1 – use of vessels applicable to all decommissioning activities and full removal of topsides and jackets

- General vessel use
- Full removal of topsides
- Full removal of jackets

Key to Risk Categories:

IV - High
III - Significant
II - Medium
I - Low

	Physical and Chemical						Biological								Societal							
	Sediment structure / chemistry	Seabed Integrity/ physical change	Water quality	Air quality (local)	Land	Fresh-water	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Ecosystem integrity	Conservation Sites	Terrestrial flora and fauna	Commercial fishing	Shipping	Government, institution users (e.g MOD)	Other commercial users	Recreation and amenity users	Onshore communities (resources)	Overall Risk Category	Justification Section Reference
General decommissioning activities – applicable to all activities																						
Planned operations																						
Physical presence of vessels															✓	✓	✓	✓	✓	✓	I	Appendix C
Anchoring of the accommodation vessel for preparation and cleaning		✓					✓		✓			✓	✓								II	Section 9
Underwater noise from Dynamic Positioning vessels, engines and on-board equipment									✓	✓											II	Section 8
Operational discharges of treated oily bilge			✓					✓	✓		✓										I	Appendix C
Waste produced from onsite vessels				✓										✓						✓	I	Appendix C
Sewage and grey water discharges			✓					✓	✓												I	Appendix C
Macerated food waste discharge			✓					✓	✓												I	Appendix C
Ballast water uptake and discharge from the vessels on site							✓	✓	✓			✓	✓								I	Appendix C
Atmospheric emissions from vessels				✓																	II	Section 7
Atmospheric emissions from helicopters				✓																	II	Section 7
Unplanned Operations																						
Dropped objects	✓	✓													✓			✓			I	Appendix C
Vessel to vessel collision			✓		✓			✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	II	Section 12
Full removal of topsides and jackets – single or multiple lifts																						
Planned operation																						
Topside preparation for removal using hot cut, welding, etc.			✓	✓				✓	✓												I	Appendix C
Engineering down and cleaning			✓					✓	✓				✓								I	Appendix C
Power generation for underwater cutting of jackets legs				✓																	I	Appendix C
Power generation for topside separation and cutting (plasma, flame or cold cutting)				✓																	I	Appendix C
Topside separation and cutting (plasma, flame or cold cutting)			✓	✓				✓	✓												I	Appendix C
Underwater cutting of jacket piles 3 m below seabed	✓		✓				✓		✓	✓			✓								II	Section 9
Power generation for HLV onsite, during transportation to shore and transfer of modules to cargo barge				✓																	II	Section 7
Power generation for dismantling structures onshore				✓																	I	Appendix C
Dismantling structures/ recovery of materials onshore				✓	✓	✓														✓	I	Appendix C
Unplanned operations																						
Topside and/ or jacket loss during lifting and transportation	✓	✓	✓				✓		✓				✓								I	Appendix C
Loss of minor/ small items e.g., scaffold within 500 m of the platform		✓						✓		✓			✓								I	Appendix C

Table 6.7: Activities associated with VDP1 activities – decommissioning *in situ* pipelines and mattresses

- **Decommissioning pipelines *in situ***
- **Decommissioning mattresses *in situ***

Key to Risk Categories:

IV - High
III - Significant
II - Medium
I - Low

	Physical and Chemical						Biological								Societal							
	Sediment structure / chemistry	Seabed Integrity/ physical change	Water quality	Air quality (local)	Land	Fresh-water	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Ecosystem integrity	Conservation Sites	Terrestrial flora and fauna	Commercial fishing	Shipping	Government, institution users (e.g., MOD)	Other commercial users	Recreation and amenity users	Onshore communities (resources)	Overall Risk Category	Justification Section Reference
Decommissioning pipelines *in situ* – minimal intervention																						
Planned operations																						
Physical presence of *in situ* pipelines	✓	✓	✓				✓	✓					✓		✓						II	Section 9
Dredging operations to water jet out pipeline at each end (diver operated)	✓	✓	✓				✓		✓			✓	✓								I	Appendix C
Rock placed on the seabed cover the pipeline ends (as above)	✓	✓					✓	✓	✓			✓	✓								III	Section 9
Cutting the pipelines with diamond wires	✓		✓						✓			✓	✓								I	Appendix C
Residual contaminants released from degrading pipelines decommissioned *in situ*	✓		✓				✓	✓	✓												II	Section 9
Waste management (marine growth, NORM, landfill use)					✓	✓													✓	✓	II	Section 12
Decommissioning mattresses *in situ* – minimal disposal option																						
Planned Operations																						
Physical presence of mattresses	✓	✓	✓				✓	✓					✓		✓						III	Section 9

Table 6.8: Activities associated with LDP1 activities – use of vessels applicable to all decommissioning activities and full removal of topsides and jackets

- **General vessel use**
- **Full removal of topsides**
- **Full removal of jackets**

Key to Risk Categories:

IV - High
III - Significant
II - Medium
I - Low

	Physical and Chemical						Biological								Societal							
	Sediment structure / chemistry	Seabed Integrity/ physical change	Water quality	Air quality (local)	Land	Fresh-water	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Ecosystem integrity	Conservation Sites	Terrestrial flora and fauna	Commercial fishing	Shipping	Government, institution users (e.g MOD)	Other commercial users	Recreation and amenity users	Onshore communities (resources)	Overall Risk Category	Justification Section Reference
General decommissioning activities – applicable to all activities																						
Planned operations																						
Physical presence of vessels															✓	✓	✓	✓	✓	✓	I	Appendix C
Anchoring of the accommodation vessel for preparation and cleaning		✓					✓		✓			✓	✓								II	Section 9
Underwater noise from Dynamic Positioning vessels, engines and on-board equipment									✓	✓											II	Section 8
Operational discharges of treated oily bilge			✓					✓	✓		✓										I	Appendix C
Waste produced from onsite vessels				✓										✓						✓	I	Appendix C
Sewage and grey water discharges			✓					✓	✓												I	Appendix C
Macerated food waste discharge			✓					✓	✓												I	Appendix C
Ballast water uptake and discharge from the vessels on site							✓	✓	✓			✓	✓								I	Appendix C
Atmospheric emissions from vessels				✓																	II	Section 7
Atmospheric emissions from helicopters				✓																	II	Section 7
Unplanned operations																						
Dropped objects	✓	✓													✓			✓			I	Appendix C
Vessel to vessel collision			✓		✓			✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	II	Section 12
Full removal of the topsides and jackets – single or multiple lifts																						
Planned operation																						
Topside preparation for removal using hot cut, welding, etc.			✓	✓				✓	✓												I	Appendix C
Engineering down and cleaning			✓					✓	✓				✓								I	Appendix C
Power generation for topside separation and cutting (plasma, flame or cold cutting)				✓																	I	Appendix C
Topside separation and cutting (plasma, flame or cold cutting)			✓	✓				✓	✓												I	Appendix C
Power generation for underwater cutting of jackets legs				✓																	I	Appendix C
Underwater cutting of jacket piles 3 m below seabed	✓		✓				✓		✓	✓			✓								II	Section 9
Power generation for HLV onsite, during transportation to shore and transfer of modules to cargo barge				✓																	II	Section 7
Power generation for dismantling structures onshore				✓																	I	Appendix C
Dismantling structures/ recovery of materials onshore				✓	✓	✓														✓	I	Appendix C
Unplanned operations																						
Topside and/ or jacket loss during lifting and transportation	✓	✓	✓				✓		✓				✓								I	Appendix C
Loss of minor/ small items e.g., scaffold within 500 m of the platform		✓						✓		✓			✓								I	Appendix C

Table 6.9: Activities associated with LDP1 activities – decommissioning *in situ* pipelines and mattresses, full removal of LOGGS T-piece

- **Decommissioning pipelines *in situ***
- **Decommissioning mattresses *in situ***
- **Full removal of T-piece**

Key to Risk Categories:

IV - High
III - Significant
II - Medium
I - Low

	Physical and Chemical						Biological								Societal							
	Sediment structure / chemistry	Seabed Integrity/ physical change	Water quality	Air quality (local)	Land	Fresh-water	Sediment biology (benthos)	Water column (plankton)	Finfish and shellfish	Sea mammals	Seabirds	Ecosystem integrity	Conservation Sites	Terrestrial flora and fauna	Commercial fishing	Shipping	Government, institution users (e.g MOD)	Other commercial users	Recreation and amenity users	Onshore communities (resources)	Overall Risk Category	Justification Section Reference
Decommissioning pipelines *in situ* – minimal intervention																						
Planned operations																						
Physical presence of *in situ* pipelines	✓	✓	✓				✓	✓					✓		✓						II	Section 9
Dredging operations to water jet out pipeline at each end (diver operated)	✓	✓	✓				✓		✓			✓	✓								I	Appendix C
Rock placed on the seabed to cover the pipeline ends(as above)	✓	✓					✓		✓			✓	✓								III	Section 9
Cutting the pipelines with diamond wires	✓		✓						✓			✓	✓								I	Appendix C
Residual contaminants released from degrading pipelines decommissioned *in situ*	✓		✓				✓	✓	✓												II	Section 9
Waste management (marine growth, NORM, landfill use)					✓	✓													✓	✓	II	Section 12
Decommissioning mattresses *in situ* – minimal disposal option																						
Planned operations																						
Physical presence of mattresses	✓	✓	✓				✓	✓					✓		✓						III	Section 9
Full removal of the LOGGS T-piece																						
Planned operations																						
Removing grout bags	✓	✓					✓					✓	✓								I	Appendix C
Removing protective structure	✓	✓					✓					✓	✓								I	Appendix C
Lift the LOGGS T-piece using DSV	✓	✓	✓				✓		✓			✓	✓								I	Appendix C
Unplanned operations																						
Accidentally dropped sections of T-piece during removal operations		✓					✓		✓				✓								I	Appendix C

7.0 ENERGY AND EMISSIONS

This section provides quantitative estimates of the energy use and the atmospheric emissions from the decommissioning operations and end points for the VDP1 and LDP1 facilities. The potential for environmental impact and mitigation measures to minimise emissions and optimise energy use is also assessed.

7.1 Regulatory Context

Atmospheric emissions generated from the decommissioning of the VDP1 and LDP1 facilities will be managed in accordance with current legislation and standards as detailed within Appendix A.

7.2 Approach

This assessment is 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). The assessment includes:

- Establishment of a materials inventory for each structure to be decommissioned;
- Identification of all operations associated with the decommissioning options;
- Identification of all end points associated with decommissioning each structure (end points are defined as the final states of the materials at the cessation of the decommissioning operations); and
- Selection of conversion factors and subsequent calculation of energy use and atmospheric emissions.

The calculations predominantly use the energy use and atmospheric emission factors provided within IoP (2000) guidelines. In accordance with these guidelines, alternative factors may be used where specific equipment is considered to have a significantly different fuel use from that presented in the IoP database. Appendix D details the factors used for the energy and emissions calculations associated with the manufacture of new materials, recycling of materials, general fuel consumption and vessel fuel use.

7.3 Sources of Potential Impacts

This section reports the findings of the energy and emissions assessment which considered, where appropriate, the following sources for each stage of the decommissioning process for the VDP1 and LDP1 facilities:

- Vessels for transportation and offshore operations;
- Helicopters for transportation of personnel;
- Onshore dismantling and/ or processing of materials;
- Onshore transportation to processing, recycling and landfill sites;
- Manufacture or sourcing of new items (e.g., rock-placement and temporary steel work) required for decommissioning operations;
- Recycling; and
- New manufacture to replace recyclable materials decommissioned at sea or disposed of in landfill.

7.3.1 Assumptions

The following sub-sections outline the assumptions relevant to the VDP1 and LDP1 decommissioning activities as a whole and those assumptions specific to particular components of the infrastructure (for example, topsides, jackets and pipelines).

General assumptions

For the calculation of the energy use and gaseous emissions, the following assumptions were made. These are applicable to all the components of the VDP1 and LDP1 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 VDP1 and LDP1 decommissioning activities.
- A round trip by helicopter to the centre of the VDP1/ LDP1 area takes, approximately, one hour. The helicopter (Superpuma) uses approximately, 1,030 litres of aviation fuel per hour (Airbus, 2014).
- Energy use and emissions calculations for vessel use are based on a worst-case scenario of type of vessel used for the operations (e.g., a Single-Lift Vessel (SLV) may be used as an alternative to a HLV where appropriate; Table 7.1). Therefore energy use and gaseous emissions for vessel use may be an overestimate.
- A Construction Support Vessel (CSV) may not be required for decommissioning activities and its inclusion in the vessel scope may therefore lead to an overestimate of energy use and gaseous emissions.
- Vessels associated with rock-placement for the stabilisation of the AWV have not been incorporated in this assessment. The exact quantity of rock required for stabilisation at the platform locations (Section 3.8) is currently under review. Therefore the number of vessels and duration of each rock-placement operation is unknown. As the placement of rock on the seabed is to provide stabilisation of the AWV at seven of the eight platform locations, there will be an increase in energy use and gaseous emissions. A direction for deposits application will be submitted to the DECC to seek approval for the commencement of the rock-placement operations. The volume of rock will be detailed within each application, will be based on the final SSA results (Section 3.8), include detailed berm design drawings and will identify, quantify and assess the risks associated with each rock placement operation.
- Seabed surveys are accounted for within both the VDP1 and LDP1 areas.
- Recovered material is assumed to be landed at Hartlepool (Teesside Docks) and subsequently taken to landfill and/or recycling sites, approximately, 1 km to the north of the landing site:
    - Any component potentially containing NORM is assumed to have the NORM material removed and this material will be packaged and transported to the Kings Cliffe disposal facility in Northamptonshire, approximately, 266 km to the south; and
    - Any waste requiring incineration is assumed to be sent to Ellesmere Port on Merseyside, approximately, 150 km to the west of the landing site.

  Insufficient information is presently available to be certain which landing and onshore processing locations will be selected because the waste contractor is not yet selected

and so it is necessary to make this assumption to account for onshore transportation within the energy and emissions budget.

- Material is transported by lorries 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.
- The energy use associated with the offshore and onshore deconstruction of materials is calculated according to the IoP factor for "overall dismantling" (IoP, 2000). This assumption has been made for two reasons. Firstly, there is inconsistency in the level of information provided by contractors on the fuel use of their deconstruction equipment. Secondly, there is an absence of published data on the deconstruction of different types of materials and components. Therefore an overall value is used to allow a comparison between this and other studies.
- Conversion factors (IoP or otherwise) are not available for the emissions associated with overall dismantling.
- A theoretical replacement value is calculated for recyclable material decommissioned *in situ* or disposed of in a landfill site.
- 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.

Topside assumptions

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

- No material is decommissioned *in situ*;
- It has been assumed here, as a worst-case, that all topsides and jackets will be decommissioned separately. In reality, several of the platforms may be lifted as a single entity;
- All recovered material that can be recycled will be where practical, and any remaining material will be sent to landfill;
- Material sent to landfill has been accounted for under "New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill";
- There is assumed to be one helicopter flight per working day during the vessel scope (worst case-scenario); and
- An estimate of 20% Wait on Weather (WOW) contingency is applied to all vessels involved with the topsides removal. This estimate is based on working days only.

Jacket assumptions

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

- No material is decommissioned *in situ* above the seabed.
- All recovered steel and anode material from the jacket is recycled.
- Some steel will remain *in situ* below the seabed. As the precise amount to be removed/ decommissioned *in situ* is governed by the location of the sub-seabed cut, it has been assumed that any steel below the seabed will be decommissioned *in situ*. This has been accounted for in the calculations for replacement. In reality, a portion of this amount will be removed with the rest of the jacket. Given that more energy is required for the remanufacture of steel decommissioned *in situ* than the recycling of

steel removed (IoP, 2000; Appendix D), this may lead to a small over-estimate of the energy use and gaseous emission values associated with jacket decommissioning.

- As the jacket's aluminium (anode) components are indistinguishable from the surrounding steel, energy and emissions values associated with steel recycling and replacement have been used. Since the aluminium yields higher energy and emissions values for recycling and replacement, the outcome will be considered as an under-estimate.
- There will be one helicopter flight per working day during the vessel scope (this is a worst-case scenario and may lead to an over-estimate of the energy use and emissions associated with helicopter transport). An estimate of 20% WOW contingency has been applied to all vessels involved with jackets removal. This estimate is based on working days only.

Pipeline assumptions

The following assumptions were made that apply to the pipeline decommissioning.

- All the recovered steel and anode material is recycled; recovered concrete, plastic and coal tar coatings will be taken to landfill.
- Where energy and emissions values are available for a particular material, any items decommissioned *in situ*, lost to landfill or incinerated have been accounted for in the calculations for replacement. This assessment does not include the materials which do not have representative energy and emissions values for re-manufacture and may therefore lead to an under-estimate of the associated energy use and emissions.
- Any steel component which has been exposed to production fluids is assumed to contain naturally occurring radioactive material (NORM), NORM material will be removed and transported to the Kings Cliffe disposal facility in Northamptonshire, approximately, 266 km to the south, for disposal to landfill.
- Recovered concrete and plastic associated with the pipelines is assumed to be removed and taken directly to landfill in Hartlepool (2 km over-land return journey).
- Further monitoring surveys are likely to be required for material decommissioned *in situ*. The frequency of these monitoring surveys is still to be agreed with DECC. For the purposes of this assessment it is assumed that post-decommissioning surveys will be required.
- Where removal and general decommissioning operations are undertaken, vessel WOW days are proportionate to days spent in transit and working on-site. WOW is represented by, approximately, 33% of the total transit and working days.
- WOW for surveys is based on 50% of the total working days for a survey vessel.
- Rock-placement operations and subsea structure removal have a 50% tidal contingency and a 20% WOW contingency included in the estimation of vessel days. These percentages are based on working days only.
- Pipeline cleaning operations have a 20% WOW contingency built-in. This contingency is based on working days only.
- Both rock-placement and trenching methods are being considered as burial options for the pipeline ends where required. In this instance, rock-placement has been used as a representative burial method. Rock-placement has therefore been accounted for in the "Manufacturing of new materials" and in the "Vessel and helicopter use" categories as a worst-case scenario.

- Calculations of vessel requirements for rock-placement activities are based on a vessel with a capacity of 24,000 tonnes, with the ability to place, approximately, 2,000 tonnes of rock on the seabed every hour (Vuyk Engineering, Rotterdam B.V., 2014).
- There will be one helicopter flight per day during pipeline decommissioning.
- A small number of mattresses/ grout bags may need to be removed to gain access to make cut at the pipeline ends during the removal of the T-piece. These will be disposed of in landfill. The exact quantity is not known at present and as a result these have not been accounted for. Details will be provided in subsequent consent applications. As a result there is an under-estimation of the associated energy use and emissions in relation to these activities.

7.3.2 Materials inventory

Inventories of materials are based on the D3 Consulting (2014) materials inventory report and are provided within Section 3, Tables 3.17 and 3.18.

7.3.3 Vessels

Table 7.1 summarises the vessels expected to be associated with the decommissioning of the VDP1 and LDP1 facilities. It is likely that a SLV will be used for the removal of some installations. However, a HLV has been used for the energy and emissions calculations as a worst-case scenario. The use of a CSV has also been included here to represent a worst-case scenario. In reality it is unlikely that a CSV will be required.

Table 7.1: Summary of vessel use during the decommissioning of the VDP1 and LDP1 facilities

Facility	Recommended Decommissioning Option	Decommissioning Method	Vessel use	Relevant Section
Topsides	Full removal	Single Lift	HLV, CSV.	7.3.4
Jackets	Full removal	Single Lift	HLV, CSV, Survey vessel.	7.3.5
Pipelines	Decommission *in situ*, minimum intervention	Cut and lift pipeline ends and cover with rock/ trench in place. Decommission associated pipeline stabilisation features (mattresses and grout bags) in place.	AWV, DSV, CSV, Survey vessel, Supply vessel, MSV*.	7.3.6
Subsea structure (T-piece) (LDP1 only)	Full removal	Cut and lift	Supply vessel, DSV, Survey vessel.	7.3.7

*Multi-support Vessel (MSV).

7.3.4 Topsides

Estimated energy use and atmospheric emissions during full removal of the topsides for VDP1 and LDP1 are detailed within Tables 7.2 and 7.3, respectively. Energy use and emissions are expected to arise due to vessel and helicopter use for preparation, cleaning and removal operations, onshore deconstruction, transportation of topsides components to decontamination, recycling and/ or landfill facilities and the manufacture of otherwise recyclable materials lost to landfill.

Table 7.2: Energy use and atmospheric emissions for decommissioning the VDP1 topsides

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Vessel and helicopter use	176,634	13,101	239	16	1
Onshore transportation	28	2	0	0	ND
Onshore deconstruction	1,221	ND	ND	ND	ND
Recycling	7,700	813	1	4	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	682	21	ND	ND	ND
Total	**186,265**	**13,937**	**240**	**20**	**1**

Note:
ND = No Data
Values have been rounded to the nearest whole number

The operations for the removal of the VDP1 topsides are predicted to use 186,265 GJ of energy. Approximately 95% of this is attributed to vessel and helicopter use.

Table 7.3: Energy use and atmospheric emissions for decommissioning the LDP1 topsides

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Vessel and helicopter use	113,265	8,401	154	11	1
Onshore transportation	74	5	0	0	ND
Onshore deconstruction	1,743	ND	ND	ND	ND
Recycling	12,267	1,314	2	7	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	599	18	ND	ND	ND
Total	**127,948**	**9,738**	**156**	**18**	**1**

Note:
ND = No Data
Values have been rounded to the nearest whole number

The operations for the removal of the LDP1 topsides are predicted to use 127,948 GJ of energy. Approximately 89% of this is attributed to vessel and helicopter use.

7.3.5 Jackets

The estimated energy use and atmospheric emissions associated with the full removal of the jackets for VDP1 and LDP1 are detailed within Tables 7.4 and 7.5, respectively. The energy use and atmospheric emissions are expected to arise due to vessel and helicopter use for jacket removal operations, the onshore deconstruction and transportation of NORM contaminated material to a disposal plant.

The operations for the removal of the VDP1 jackets are predicted to use 233,685 GJ of energy. Approximately 76% of this is attributed to vessel and helicopter use, 15% is attributed to recycling and 7% to new manufacture to replace materials lost to society.

Table 7.4: Energy use and atmospheric emissions for decommissioning the VDP1 jackets

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Vessel and helicopter use	176,634	13,101	239	16	1
Onshore transportation	13	1	0	0	ND
Onshore deconstruction	4,624	ND	ND	ND	ND
Recycling	36,189	3,860	6	15	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	16,225	1,226	2	4	ND
Total	**233,685**	**18,188**	**247**	**35**	**1**

Note:
ND = No Data
Values have been rounded to the nearest whole number

The operations for the removal of the LDP1 jackets are predicted to use 162,980 GJ of energy. Approximately 69% of this is attributed to vessel and helicopter use, 14% is attributed to recycling and 15% to new manufacture to replace materials lost to society.

Table 7.5: Energy use and atmospheric emissions for decommissioning the LDP1 jackets

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Vessel and helicopter use	113,265	8,401	154	11	1
Onshore transportation	12	1	0	0	ND
Onshore deconstruction	2,824	ND	ND	ND	ND
Recycling	22,104	2,358	4	9	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	24,775	1,872	3	5	ND
Total	**162,980**	**12,632**	**161**	**25**	**1**

Note:
ND = No Data
Values have been rounded to the nearest whole number

7.3.6 Pipelines

The estimated energy use and atmospheric emissions during pipeline decommissioning for VDP1 and LDP1 are detailed within Tables 7.6 and 7.7, respectively. Energy use and atmospheric emissions are expected to arise mainly due to vessel and helicopter use for pipeline decommissioning operations, including the removal of the pipeline ends, pipeline cleaning, and surveys of the seabed (including one post-decommissioning and three monitoring surveys). As the pipeline ends will either be covered by rock or trenched in place, the manufacture and deposition of rock over exposed pipeline ends has also been accounted for to represent a worst-case scenario. The onshore transportation of pipeline components for decontamination, recycling and/ or landfill facilities and the manufacture of otherwise recyclable materials lost to landfill/ decommissioned *in situ* (including protective material) has also been accounted for.

Table 7.6: Energy use and atmospheric emissions for decommissioning the VDP1 pipelines

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Manufacturing of new materials	12.5	1	0.4	0.7	ND
Vessel and helicopter use	155,485	11,530	210	14	ND
Onshore transportation	9	1	0	0	ND
Recycling	26	3	0.005	0.01	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	92,268	8,526	23	20	ND
Total	**247,801**	**20,061**	**233**	**35**	**ND**

Note:
ND = No Data
Values have been rounded to the nearest whole number

The operations for the decommissioning of the VDP1 pipelines are predicted to use 247,801 GJ of energy. Approximately 63% of this is attributed to vessel and helicopter use and a further 37% is attributed to new manufacture to account for material lost to society. Most of the material lost to society will be decommissioned *in situ*.

Table 7.7: Energy use and atmospheric emissions for decommissioning the LDP1 pipelines

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Manufacturing of new materials	10	1	0	1	ND
Vessel and helicopter use	113,736	8,436	154	10	ND
Onshore transportation	9	1	0	0	ND
Recycling	23	2.5	0	0	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	101,150	8,626	22	21	ND
Total	**214,928**	**17,067**	**176**	**32**	**ND**

Note:
ND = No Data
Values have been rounded to the nearest whole number

The operations for the removal of the LDP1 pipelines are predicted to use 214,928 GJ of energy. Approximately 53% of this is attributed to vessel and helicopter use and a further 47% is attributed to new manufacture to account for material lost to society. Most of the material lost to society will be decommissioned *in situ*.

7.3.7 LDP1 T-piece

Estimated energy use and atmospheric emissions during removal of the LDP1 (Vampire/ Viscount) T-Piece by cut and lift are detailed in Table 7.8. The operations are predicted to use 9,289 GJ of energy. Approximately 97% of this is attributed to vessel and helicopter use.

Table 7.8: Energy use and atmospheric emissions for decommissioning the LDP1 T-piece

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Vessel and helicopter use	8,965	665	12	1	ND
Onshore transportation	9	1	0	0	ND
Recycling	315	34	0	0	ND
Total	**9,289**	**700**	**12**	**1**	**ND**

Note:
ND = No Data
Values have been rounded to the nearest whole number

7.3.8 Summary

Tables 7.9 and 7.10 summarise the total energy use for the VDP1 and LDP1 decommissioning operations, respectively.

The operations for the decommissioning of the VDP1 facilities are predicted to use a total of 667,751 GJ of energy. Approximately 76% of this is attributed to vessel and helicopter use and as a result vessel and helicopter use is responsible for 72% of the associated CO_2 emissions. Significant contributions to energy use can also be attributed to new manufacture to account for material lost to society (16%) and recycling (7%) (Table 7.9).

Table 7.9: Total energy use and atmospheric emissions for VDP1 decommissioning activities

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Manufacturing of new materials	13	1	0	1	ND
Vessel and helicopter use	508,753	37,732	687	47	2
Onshore transportation	50	4	0	0	ND
Onshore deconstruction	5,845	ND	ND	ND	ND
Recycling	43,915	4,676	7	19	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	109,175	9,773	25	24	ND
Total	**667,751**	**52,186**	**720**	**91**	**2**

Note:
ND = No Data
Values have been rounded to the nearest whole number

The operations for the decommissioning of the LDP1 facilities are predicted to use a total of 515,145 GJ of energy. Approximately 68% of this is attributed to vessel and helicopter use. As a result, vessel and helicopter use is also responsible for 65% of the associated CO_2 emissions. Significant contributions to energy use can also be attributed to new manufacture to account for material lost to society (25%) and recycling (7%) (Table 7.10).

Table 7.10: Total energy use and atmospheric emissions for LDP1 decommissioning activities

Decommissioning aspect	Energy (GJ)	Emissions (tonnes)			
		CO_2	NOx	SO_2	CH_4
Manufacturing of new materials	10	1	0	1	ND
Vessel and helicopter use	349,230	25,903	473	32	1
Onshore transportation	104	8	0	0	ND
Onshore deconstruction	4,567	ND	ND	ND	ND
Recycling	34,709	3,708	6	16	ND
New manufacture to replace recyclable materials decommissioned *in situ* or taken to landfill	126,524	10,516	25	26	ND
Total	**515,144**	**40,136**	**505**	**75**	**1**

Note:
ND = No Data
Values have been rounded to the nearest whole number

7.4 Impacts on Sensitive Receptors

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

The direct effect of NOx, SOx and VOC emissions is the formation of photochemical pollution in the presence of sunlight. Low level ozone is the main chemical pollutant formed, with by-products that include nitric and sulphuric acid and nitrate particulates. The effects of acid formation include contribution to acid rain formation and dry deposition of particulates.

The main environmental effect resulting from the emission of SO_2 is the potential to contribute to the occurrence of acid rain; however the fate of SO_2 is difficult to predict due to its dependence on weather.

The exposed offshore conditions will promote the rapid dispersion and dilution of these emissions. Outside the immediate vicinity of the decommissioning activities, all released gases would only be present in low concentrations. The VDP1 facilities are located between 130 and 150 km east of the nearest UK coastline and the LDP1 facilities are located between 120 and 130 km east of the nearest UK coastline. No impact is expected for designated coastal or onshore conservation sites from offshore emissions. Potential impacts from onshore emissions are likely to be minor and within local and regional air quality criteria.

Harbour porpoise is the only Annex II species recorded with frequent sightings in the vicinity of the VDP1 and LDP1 facilities. In the open conditions that prevail offshore, the atmospheric emissions generated during the decommissioning activities would be quickly dispersed. The atmospheric emissions from the proposed activities are therefore considered unlikely to have any effect on marine mammals.

In summary, the atmospheric emissions from the VDP1 and LDP1 decommissioning activities are unlikely to have any effect on sensitive receptors.

7.5 Cumulative and Transboundary Impacts

The VDP1 and LDP1 facilities are located between approximately 40 and 70 km west of the UK/ Norwegian median line and released gases may be present in very low concentrations across this boundary. However, under the exposed offshore conditions, the quantity of additional air emissions produced is unlikely to create any measurable transboundary impacts.

The potential cumulative effects associated with atmospheric emissions produced by the decommissioning activities includes a contribution to climate change by emission of greenhouse gases, acidification (acid rain) and local air pollution. The total CO_2 emissions from the proposed decommissioning operations for VDP1 (52,185 tonnes CO_2) represent 0.36% of the total annual CO_2 offshore emissions from the UKCS in 2013 and the total CO_2 emissions from LDP1 (40,136 tonnes CO_2) represent 0.28% of the total UKCS 2013 emissions (14,310,000 tonnes CO_2; OGUK, 2014).

7.6 Mitigation Measures

Mitigation measures to minimise energy use and atmospheric emissions during the VDP1 and LDP1 decommissioning operations are detailed within Table 7.11.

Table 7.11: Planned mitigation measures

Planned mitigation measures
• Vessels will be audited as part of selection and pre-mobilisation. • All generators and engines will be maintained and operated to the manufacturers' standards to ensure maximum efficiency. • Vessels will use ultra-low sulphur fuel in line with MARPOL requirements. • Work programmes will be planned to optimise vessel time in the field. • Fuel consumption will be minimised by operational practices and power management systems for engines, generators and other combustion plant and maintenance systems.

7.7 Conclusions

The following conclusions can be derived:

7.7.1 VDP1 energy usage and emissions

- The total energy usage resulting from decommissioning the VDP1 facilities is estimated to be 667,751 GJ, of which 76% can be attributed to vessel and helicopter use. Standard mitigation measures have been identified to minimise energy usage by project vessels.
- Emissions from the VDP1 decommissioning activities will contribute to greenhouse gas emissions and have a non-significant cumulative and transboundary impact. Emissions will be kept to a practicable minimum. Total CO_2 emissions generated from the proposed VDP1 decommissioning operations will represent a very small proportion (0.36%) of the of the total annual CO_2 offshore emissions from the UKCS in 2013.

7.7.2 LDP1 energy usage and emissions

- The total energy usage resulting from decommissioning the LDP1 facilities is estimated to be 515,145 GJ, of which 68% can be attributed to vessel and helicopter

use. Standard mitigation measures have been identified to minimise energy usage by project vessels.

- CO_2 emissions from the LDP1 decommissioning activities will contribute to greenhouse gas emissions and have a non-significant cumulative and transboundary impact and will be kept to a practicable minimum. Total CO_2 emissions generated from the proposed LDP1 decommissioning operations will represent a very small proportion (0.28%) of the of the total annual (2013) UKCS CO_2 emissions.

7.7.3 Combined VDP1 and LDP1 emissions

- Emissions from the decommissioning activities will have a localised effect on air quality. The impact on air quality is unlikely to affect any sensitive receptors within the VDP1 and LDP1 area as the impact is expected to be limited to the operation's immediate vicinity. For this reason, there is unlikely to be a significant transboundary or cumulative impact on air quality.

8.0 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 decommissioning of the proposed VDP1 and LDP1 facilities, noise may be generated by a number of sources including:

- An Accommodation Works Vessel (AWV);
- A Dive Support Vessel (DSV);
- A guard vessel;
- A Construction Support Vessel (CSV);
- A Heavy Lift Vessel (HLV);
- Supply vessels;
- Helicopters and aircraft;
- Rock-placement vessel and operations;
- Pipeline cutting and jacket cutting;
- Lifting and removing the platforms; and,
- Well plug and abandonment 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 VDP1 and LDP1 decommissioning activities. Information to compile this section has been taken from the Noise Assessment Report for the SNS Phase 1 Decommissioning Project (Aspects associated the Viking and LOGGS Satellite platforms and infield pipelines) (BMT Cordah, 2014c).

8.1 Regulatory Context

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

According to these regulations, it is an offence to:

- Deliberately capture, injure or kill any wild animal of an EPS; or
- Deliberately disturb wild animals of any such species.

- Disturbance of animals is defined under the regulations and includes, in particular, any disturbance which is likely to impair their ability to:
- Survive, breed, rear or nurture their young;
- Hibernate or migrate (where applicable); or
- Significantly affect the local distribution or abundance of the species to which they belong.

In a marine setting, EPS include all species of cetaceans (whales, dolphins and porpoises) (JNCC, 2010b). 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 (JNCC, 2010b).

Further detail on the relevant regulations is provided in Appendix A.

8.2 Approach

The approach followed in this assessment 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.

8.2.1 Noise sources

Sound can be categorised as:

- Continuous noise, where there are no sudden rises or falls in pressure such as vessel movements or drilling; or
- Impulsive noise when it is generated from activities which either involve a rapid release of energy, e.g., seismic surveying or explosives use, or is generated through repeated mechanical impact, e.g. hydraulic pile driving.

The European Marine Strategy Framework Directive (MSFD) (2008/56/EC) suggested measures to assess underwater sound. These findings were further analysed for DECC to ensure compliance (Genesis, 2011). The noise source specified in the MSFD as having the greatest potential to impact upon the marine interest species (i.e., cetaceans, pinnipeds and fish) is low and mid frequency impulsive underwater sounds within the frequency range of 10 Hz to 10 kHz.

8.2.2 Noise metrics

Different parameters are commonly used to represent the characteristics of noise source levels:

- Sound Exposure Level (SEL), which is a measure of sound level that takes into account the duration of the signal (NOAA, 2013). The SEL (in dB re 1 µPa2 s) is the time integral of the square pressure over a fixed time window, long enough to include the entire pulse (Note: re = ‘in reference to’; µPa = micropascals).
- Sound Pressure Level (SPL), which is a measure of sound that represents only the pressure component of sound (NOAA, 2013). The SPL is the decibel ratio of sound

pressure to some reference pressure in dB re 1 µPa in underwater acoustics (zero-to-peak) (Note: re = 'in reference to'; µPa = micropascals).

- Source level (SL), which is a sound level measured at a standard reference distance (1 metre) away from the source (NOAA, 2013; Richardson *et al*., 1995). The SL is expressed in dB re 1 µPa m.
- Received level (RL), the sound level modelled for a specified distance away from the source used to determine the noise level that an organism may encounter at that location. The noise intensity decreases with increasing distance from the source (See Section 8.2.3).

8.2.3 Sound propagation

As sound spreads underwater, it decreases in strength with distance from the source. This transmission loss is the sum of the spreading and attenuation losses. Spreading loss is the geometric weakening of a sound signal as it spreads outwards from a source. Attenuation losses are the physical processes and conditions in the marine environment that weaken the sound signal. These factors include sound absorption or scattering by organisms in the water column, reflection or scattering at the seabed and sea surface, and the effects of temperature, pressure, stratification and salinity. Variations in temperature and salinity with depth will cause the sound waves to be refracted downwards or reflected upwards causing increases or decreases in sound attenuation and absorption. Consequently, sound transmission will have a considerable temporal and spatial variability that is difficult to quantify.

8.3 Sources of Potential Impacts

The sound sources from the proposed decommissioning of VDP1 and LDP1 facilities include vessel movements/ operations, well plugging and abandonment activities, pipeline and jacket cutting, pipeline rock-placement, lifting and removal operations, as well as helicopter traffic.

The quantification of noise impacts from this activity has been evaluated based on relevant scientific literature (Section 8.3.2). In addition, the potential noise impacts resulting from the 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. A description of the noise quantification, the Marsh-Schulkin model and the parameters used in the model is given in Appendix E.

8.3.1 Assumptions

For all vessel operations, it was conservatively assumed that a maximum of eight vessels will be on site at any one time during VDP1 and LDP1 decommissioning operations, corresponding to a worst case scenario with multiple decommissioning activities occurring at various platforms, either at VDP1 or LDP1 locations. The model considered the sound sources from the eight vessels as a single source.

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 VDP1 and LDP1 decommissioning operations

All of the potential noise sources associated with VDP1 and LDP1 decommissioning operations are classed as continuous sounds and, as such, do not fall into the target MSFD descriptor for loud, low-frequency impulsive sounds. The dominant sound source will be vessel noise, which is classed as a non-pulse noise source.

Of note here is that the use of explosives is not currently anticipated by ConocoPhillips during the decommissioning activities of VDP1 and LDP1 facilities.

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 the vessel's operating status and can therefore vary considerably with time. In general, vessels produce noise over the range 100 Hz to 10 kHz, with strongest energy over the range 200 Hz to 2 kHz.

Vessel noise levels are a required model input, however there is a limited amount of published data. This model has used data from Hallett (2004) to represent the eight vessels in the present scenario. Hallett (2004) investigated the 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 VDP1 and LDP1 decommissioning operations, it is considered that the results of this study provide 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.

Pipeline and jacket cutting

The jacket members will be severed at the seabed using either diamond-wire cutting or abrasive water jetting tools. Pipelines would be exposed using jetting methods (where required) 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 jacket cutting is expected to be temporary and short-term. No studies are currently available in the literature referring to noise assessments from either pipeline or jacket cutting. However, it may be expected that target species could be temporarily disturbed.

Well plugging and abandonment using a jack-up drilling rig

Underwater sound levels from all types of drilling platforms are increased during drilling periods in comparison to non-drilling periods. The well abandonment operations for the VDP1 and LDP1 facilities will use the Ensco 92 jack-up rig, with operations having commenced in June 2014. Jack-up drill rigs do not use any form of anchor and are positioned using large spud cans and legs which "jack-up" into the seabed. The typical arrangement is for three steel legs attached to a platform deck containing the drilling equipment, machinery and accommodation units. The Ensco 92 is not self-propelled and requires to be towed into location. The three legs are lowered until the spudcans establish a firm contact with the seabed. At the same time, the platform rises from the sea surface.

Genesis (2011) states that no studies evaluating the sound levels measured from jack-up drilling rigs are available, although it is expected that generated sound levels would be on a par with those arising from steel production platforms. Source levels can be as high as 195 dB (rms) re 1 µPa m for a drill ship, but are more typically lower for semi-submersibles and platforms at approximately 162 dB (rms) re 1 µPa m (Genesis, 2011). As such, it is expected that the source level from the well plug and abandonment activities using a jack-up rig is unlikely to exceed 162 dB (rms) re 1µPa m. The results from a study undertaken by Marine Acoustics Inc. (2011) measured the underwater noise generated by a jack-up drilling rig and are consistent with the values quoted within Genesis (2011). The source level of one of the strongest noise sources results from the jack-up drilling rig operations, the diesel engines, was estimated to be 137 dB re 1µPa @ 1 m (rms) (Marine Acoustics Inc, 2011).

Rock-placement

Rock-placement is being considered for the protection of VDP1 and LDP1 cut pipeline ends and to provide protection against possible punch-through, hang-up and seabed scour of the seabed at the AWV spud can locations. Rock-placement can be carried out by a fall pipe vessel or a side dumping vessel. Nedwell and Edwards (2004) measured the sound from a fall pipe vessel (Rollingstone) which has a specialised underwater chute that can accurately position rock on the seabed. This vessel used Dynamic Positioning (DP) and was powered by two main pitch propellers, two bow thrusters and two azimuth thrusters. The noise associated with navigation and transit has been compared, however, the noise associated with the rock-placement has not been compared; this is not thought to give a noticeable rise in noise over background levels. This is indicative of the fact that the sound levels were dominated by vessel noise and not the rock-placement activities (Nedwell and Edwards, 2004; Genesis, 2011).

As such, and as concluded in Nedwell and Edwards (2004), it is assumed that any rock-placement activities that may occur during the decommissioning of VDP1 and LDP1 facilities will be dominated by vessel noise.

Helicopters and aircraft

Helicopter activities related to the decommissioning of VDP1 and LDP1 facilities will occur throughout the year. ConocoPhillips plan to use helicopters for routine operations at a frequency of one helicopter per day.

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

When sound travels from air to water, the energy is largely reflected back from the water surface and only a small fraction of the sound produced by the helicopter is actually transmitted into the sea. Although helicopter sound is fairly broad band (0 to 20 kHz), the lower frequency sound, up to 200 Hz, is much more pronounced (Berrow *et al.,* 2002). The dominant tones in the noise spectra from helicopters are generally below 500 Hz (Richardson *et al.,* 1995). The angle at which sound from the aircraft intersects the water's surface is also important. At angles greater than 13° from the vertical, much of the incident sound is reflected and does not penetrate into the water (Richardson *et al.,* 1995).

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

8.4 Impacts on Sensitive Receptors

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

8.4.1 Fish

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, whilst a very few species can detect sounds to well 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 other 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 VDP1 and LDP1 facilities to be decommissioned are mainly “Hearing generalists”, with the exception of the European sprat and Herring, which are considered as “Specialists”.

VDP1 and LDP1 are located within the spawning grounds within Blocks 48/25, 49/16, 49/17 and 49/21 for mackerel, cod, haddock, whiting, plaice, lemon sole, sole, sandeel, sprat, and *Nephrops* (Table 8.1; Section 4).

Nursery areas have also been reported in Blocks 48/25, 49/16, 49/17 and 49/21 for mackerel, herring, cod, whiting, plaice, lemon sole, sandeels, *Nephrops*, and tope shark (Table 8.1; Section 4).

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

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

react, before further recommendations to reduce vessel-avoidance reactions can be made.

Table 8.1: Fish spawning periods at VDP1 and LDP1 areas (Blocks 49/16, 49/17 and 48/25) from January to December

Fish-Species	J	F	M	A	M	J	J	A	S	O	N	D
Mackerel												
Cod												
Haddock												
Whiting												
Plaice												
Lemon sole												
Sole												
Sandeels												
Sprat												
Nephrops												

KEY

Spawning periods

Peak spawning periods

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, 2009).

Grey Seal

Grey seals may travel past the VDP1 and LDP1 areas towards foraging grounds, but grey seal density around the area to be decommissioned diminishes with distance offshore. In Quadrants 48 and 49, between 0 and 5 grey seals could be present in a 5 x 5 km grid square at any one point in time (Section 4; Jones *et al.,* 2013).

Common/ Harbour Seal

Harbour seals are more likely to be found further offshore in the area to be decommissioned. It is likely that they are travelling to this area from haul-out sites in The Wash to forage for food. Between 1 and 50 common seals could be present in a 5 x 5 km grid square at any one point in time around VDP1 and LDP1 areas (Section 4; Jones *et al.,* 2013). Harbour seal is the only Annex II species recorded in the vicinity of VDP1 and LDP1 (Section 4).

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, 2010b; Southall *et al.,* 2007; Richardson *et al.,* 1995) including cetaceans.

The main cetacean species occurring in VDP1 and LDP1 areas (Quadrants 48 and 49) are white-beaked dolphin, white-sided dolphin and harbour porpoise, with sightings occurring throughout the year (Section 4). Further species observed in the surrounding areas include minke whale, long-finned pilot whale, bottlenose dolphin and common dolphin (Reid *et al.,* 2003; UKDMAP, 1998) (Section 4).

8.4.4 Characterisation of hearing sensitivities of marine mammals

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 8.2).

Table 8.2: Cetacean functional hearing groups

Frequency range	Estimated auditory bandwidth	Species sighted in VDP1 and LDP1 areas for the planned period of activities
Low-frequency	7 Hz – 30 kHz	Minke whale Long-finned pilot whale
Mid-frequency	150 Hz – 160 kHz	White-beaked dolphin Atlantic white-sided dolphin Bottlenose dolphin Common dolphin
High-frequency	200 Hz – 180 kHz	Harbour porpoise

Sources: Southall *et al.* 2007; UKDMAP, 1998; NOAA, 2013.

Further detail regarding the hearing capabilities of various target species in the form of audiograms have been included as part of this assessment. An audiogram is a curve of hearing threshold (SPL) as a function of frequency that describes the hearing sensitivity of an organism over its normal hearing range. The current study includes audiograms for harbour porpoise, grey and common seals (Nedwell *et al.,* 2004) and for white-beaked dolphin (Nachtigall *et al.,* 2008). In addition, a generalised Mysticetes (baleen whale) audiogram was utilised to represent the hearing ability of long-finned pilot whale and minke whale (Tech Environmental, 2006). No specific audiograms are available for common dolphins or Atlantic white-sided dolphins. However an audiogram is available for another member of the same genus as the Atlantic white-sided dolphins, the Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) (Tremel *et al.,* 1998) and it is believed that members of this genus may have similar hearing characteristics. A composite audiogram for bottlenose dolphin has been created based on three bottlenose dolphin audiograms sourced from Nedwell *et al.,* (2004).

Although the JNCC (2010b) guidance only requires the use of the Southall *et al*. (2007) approach, in order to give an additional dimension to the overall assessment, both the Southall *et al*. (2007) and Nedwell *et al*. (2007) approaches were used. Both approaches are described in more detail in the following sections.

Thresholds for injury and disturbance to marine mammals – Southall et al., (2007) approach

An animal's perceived noise level (the "received noise level") depends on the level and frequency of the sound when it reaches the animal and the animal's hearing sensitivity. In the immediate vicinity of a high sound level source, noise can have a severe effect causing a Permanent Threshold Shift (PTS) in hearing, leading to hearing loss and ultimately with increasing exposure, to physical injuries which may be fatal. However, at

greater distance from a source the noise decreases and the potential effects are diminished (Nedwell *et al.,* 2005; Nedwell and Edwards, 2004), with the potential to only cause a temporary shift in hearing thresholds (Temporary Threshold Shift (TTS)-onset).

Southall *et al.,* (2007) undertook a review of the impacts of underwater noise on marine mammals and used this to define criteria for predicting the onset of injury and behavioural response in marine mammals. This was undertaken for species with different hearing characteristics when subjected to different types of noise (Table 8.3). Of note is that, based on the proposed decommissioning operations for VDP1 and LDP1 facilities, no single pulse and/or multiple pulse noise sources/ events are anticipated.

Table 8.3: Noise types and activities associated with VDP1 and LDP1 decommissioning operations

Noise type	Definition (after Southall et al., 2007)	Decommissioning activities
Single-pulse	Brief, broadband, atonal, transient, single discrete noise events; characterised by rapid rise to peak pressure.	There are no single pulse events anticipated for VDP1 and LDP1 decommissioning operations.
Multiple-pulse	Multiple pulse events within 24 hours.	There are no multiple pulse events anticipated for VDP1 and LDP1 decommissioning operations.
Non-pulse	Intermittent or continuous, single or multiple discrete acoustic events within 24 hours; tonal or atonal and without rapid rise to peak pressure.	Vessel activity, rock-placement and well plugging and abandonment.

A set of precautionary thresholds, for peak sound pressure levels and sound exposure levels that are likely to lead to injury (PTS) and disturbance to marine mammals for different noise types, were subsequently proposed (Southall *et al.,* 2007; Table 8.4).

Southall *et al.,* (2007) also proposed a severity scaling system which ranks the behavioural response from a zero for 'no response' to a nine for 'outright panic, flight, stampede, attack of conspecifics or stranding events'. A behavioural response with a severity scale of five or six is considered to represent a disturbance, with animals showing noticeable changes in swimming pattern and minor avoidance reactions (Appendix E).

The guidance produced by JNCC (2010b) on how to assess and manage the risk of causing injury or disturbance to a marine EPS as a result of activities at sea, suggests that disturbance to a marine mammal is likely to occur from sustained or chronic behavioural response with a severity scoring of five or above, according to the behavioural response severity scale of Southall, *et al.,* (2007).

The Nedwell dBht (species) approach

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

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

Table 8.4: Precautionary thresholds for injury or disturbance to cetaceans (Southall *et al.,* 2007)

Functional hearing group	Species sighted in VDP1 and LDP1 areas	Sound measure [1]	Injury threshold for different sound types[3]			Disturbance threshold for single pulse sounds[2, 3]		
			Single-pulse	Multiple-pulse	Non-pulse	Single-pulse	Multiple-pulse	Non-pulse
Low-frequency cetaceans	Minke whale Long-finned pilot whale	SPL	230	230	230	224	-	-
		SEL	198	198	215	183	-	-
Mid-frequency cetaceans	White-beaked dolphin Atlantic white-sided dolphin Bottlenose dolphin Common dolphin	SPL	230	230	230	224	-	-
		SEL	198	198	215	183	-	-
High-frequency cetaceans	Harbour porpoise	SPL	230 (199.7[4])	230	230	224 (174[4])	-	-
		SEL	198 (164.3[4])	198	215	183 (145[4])	-	-
Pinnipeds (in water)	Grey seal Common/ harbour seal	SPL	218	218	218	212	-	-
		SEL	186	186	203	171	-	-
Pinnipeds (in air)		SPL	149	149	149	109	-	-
		SEL	144	144	144.5	100	-	-

Notes:

1. Sound measures:

   In water: SPL – zero-to-peak Sound Pressure Level in dB re 1 µPa; SEL – Sound Exposure Level in dB re 1 μPa^2s.

   In air: SPL – zero-to-peak Sound Pressure Level in dB re 20 µPa; SEL – Sound Exposure Level in dB re 20 μPa^2s. Applies to Pinnipeds (in air) only

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

3. There are no single pulse and/ or multiple pulse events anticipated for the decommissioning of VDP1 and LDP1 facilities.

4. Lucke *et al.,* (2009) defines injury and behavioural thresholds for harbour porpoise for single pulse sounds. These are more conservative than the Southall *et al.,* (2007) measurements and lower than for any other cetacean species listed in the literature to date. As stated in note 3 there are no single pulse events for VDP1 and LDP1 activities and therefore these levels are irrelevant.

8.5 Results

In accordance to JNCC guidelines, the Marsh-Schulkin model (Schulkin and Mercer, 1985) (Appendix E) 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; Table 8.4). In addition, the Nedwell $dB_{ht\ (species)}$ was then applied to determine both injury and avoidance zones for specific species in VDP1 and LDP1 decommissioning areas.

8.5.1 Prediction of injury and behavioural avoidance zones

The Southall and Nedwell approaches have been successively used to predict injury and behavioural avoidance zones for marine mammals.

Southall Criteria

To compare the Southall criteria to predicted vessel operation noise levels, the non-pulse injury threshold has been applied. The threshold for injury to cetaceans of 230 dB re 1 µPa m (Table 8.4) is higher than the model output 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 at VDP1 and LDP1. Southall *et al.,* 2007 does not provide non-pulse threshold recommendations for disturbance and therefore this method cannot be applied to determine disturbance zones.

Nedwell dB_{ht} Approach – decommissioning operations

According to Nedwell *et al.,* (2007), the sound propagation model results (Table 8.5) 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 8.5: Predicted frequencies causing greatest effect and radii within which likely avoidance and injury may occur for each species for the noise generated by the decommissioning operations at VDP1 and LDP1

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	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
Grey seal	73	178	105	10	N/A	9
Common seal	67	181	114	8	N/A	26

Notes:

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 4.
2. Propagation model output.

The noise threshold for an avoidance reaction (90 $dB_{ht\ (species)}$), may be exceeded during vessel operations. The size of the avoidance zones will vary by species and range from 9 m (grey seal) to 106 m (bottlenose dolphin) (Table 8.5). 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), white-beaked dolphin (14 m) and grey seal (9 m).

8.5.2 Comparison of results against specific audiograms

The frequency profile for the vessel operations, together with the relevant marine mammal audiograms for the likely behavioural avoidance zones and the ambient noise levels (result from sounds generated by physical factors such as wind and waves, marine mammal vocalisations and other shipping) (DEWI, 2004) are shown in Figure 8.1. Sound

levels decrease with increasing distance from the source and the attenuation rate is greater at higher frequencies than at lower frequencies.

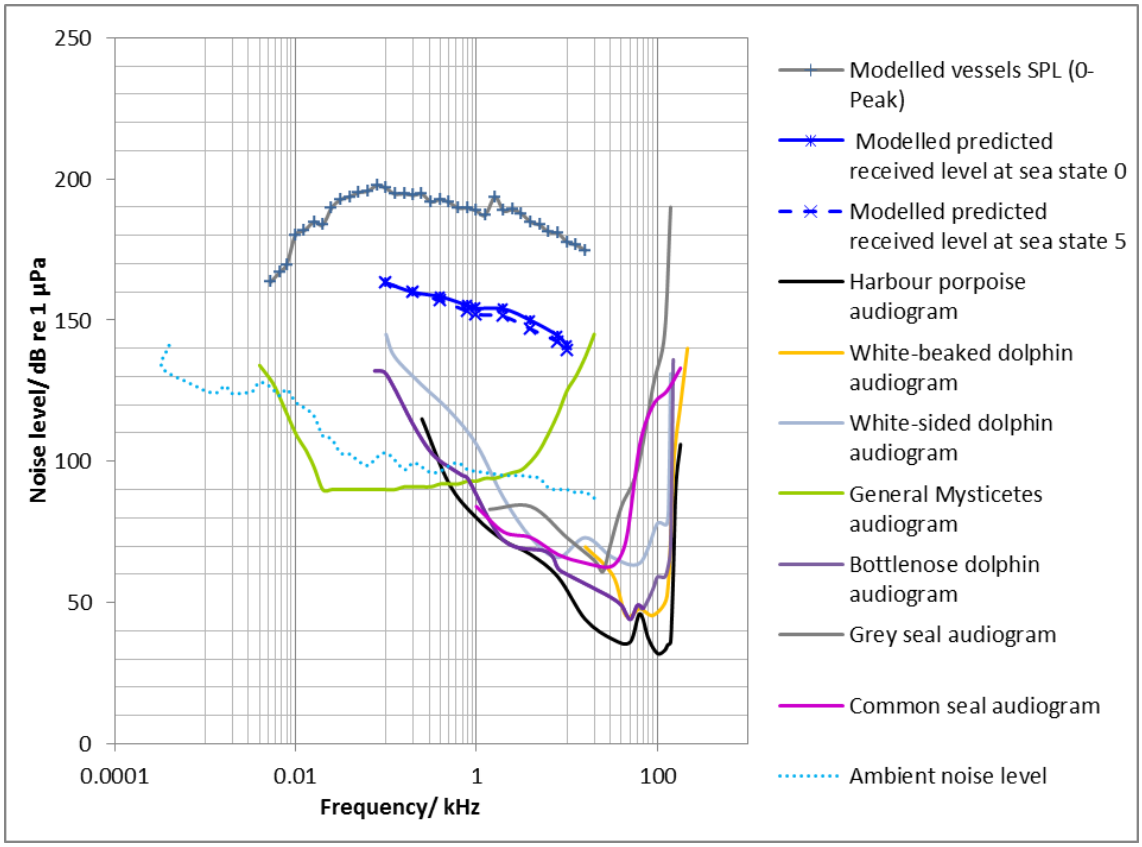

Figure 8.1: Frequency profile of received sound level of vessel operations at a radius of 106 m from source (estimated maximum extent of marine mammal behavioural avoidance zone)

Note: M-weighted audiograms represent the detection thresholds for the listed marine mammals. For example, the quietest detectable noise by a General Mysticetes at frequency of 1 kHz would be approximately 90 dB re 1µPa. The curves are 'u' shaped because the animals can only detect louder noise at the fringes of their hearing range. Blue lines with crosses represent model outputs and the distance between model output and the animals' hearing threshold is the perceived volume (Table 8.5). Ambient noise level represents the average noise level in the marine environment and is the result of wind, waves, background noise, etc. (DEWI, 2004).

Source: Generalised Mysticetes audiogram (Tech Environmental, 2006); white-beaked dolphin audiogram (Nachtigall, *et al.,* 2008); white-sided dolphin audiogram (Tremel, *et al.,* 1998); harbour porpoise, bottlenose dolphin, common and grey seals audiograms (Nedwell, *et al.,* 2004); and ambient noise levels (DEWI, 2004).

The type of data publically available for acoustic studies varies. Ambient noise and audiogram values (Figure 8.1) are presented in dB re 1 µPa (rms), whereas vessels and the modelled received sound values are given in dB re 1 µPa m (zero-to-peak).

Whilst these units are not directly comparable, zero-to-peak measurements are greater than rms values; therefore conclusions made about auditory zonal radii should be considered as conservative estimates.

Behavioural displacement of marine mammals

The MSFD (Van der Graff *et al.,* 2012) and JNCC (JNCC, 2010b) suggest that 'significant displacement' relates to a change in the natural distribution of a sufficient proportion of individuals, both temporally and spatially, such that there is an adverse

effect to a local population. Significant behavioural displacement can lead to abandonment of an area or habitat and alterations in dispersion patterns.

Approximate densities of marine mammals in VDP1 and LDP1 areas, based on the Small Cetaceans in the European Atlantic and North Sea (SCANS) II July 2005 survey (Hammond *et al.,* 2013; SCANS II, 2006) have been used to estimate the number of animals of each species potentially experiencing behavioural displacement (Table 8.6).

Of note is that the calculated number of animals temporarily displaced is likely to be an overestimate. A relationship between the SPL and likely behavioural response has not been clearly defined by the scientific community. Therefore this analysis conservatively uses the lowest reported SPL known to result in severe behavioural response. Additionally, in practice marine mammals are likely to be sparsely located, whether as individuals or groups of individuals, and move over large areas. Consequently, there may be no individuals within the estimated displacement zone at the time of the decommissioning operations within VDP1 and LDP1 areas.

The grey and common seal densities in the study area have been taken from Jones *et al*., (2013). The modelling indicates that no seals are likely to be affected by the decommissioning activities (Table 8.6).

Table 8.6: Estimated number of animals potentially experiencing behavioural displacement during VDP1 and LDP1 decommissioning operations

Species	Estimated density in area (animals/km^2) [1]	Estimated number of animals that may experience behavioural displacement [2]
Minke whale	0.023	< 1
Long-finned pilot whale	No Data	-
White-beaked dolphin and Atlantic white-sided dolphin [3]	0.003	< 1
Harbour porpoise	0.598	< 1
Common dolphin	No Data	-
Bottlenose dolphin	No Data	-
Grey seal	0.0003	< 1
Common seal	0.0021	< 1

Notes:

1. Calculation method based on Southall *et al.,* (2007) as recommended by JNCC (2010b) , with abundance given to the nearest whole animal.
2. Note that it can be difficult to distinguish between White-beaked dolphin & Atlantic white-sided dolphin in the field (Hammond *et al.,* 2013)

Source: (Hammond *et al*., 2013) for marine mammals; (Jones *et al.,* 2013) for grey and common seals.

8.5.3 Transboundary and cumulative impacts

In both VDP1 and LDP1 areas, the closest platform (Platform DD) to the median line is located, approximately 42 km west of the UK/ Norway median line. At this distance, noise levels from vessels, the greatest source of sound associated with the decommissioning of VDP1 and LDP1 facilities, would attenuate to a level lower than that likely to cause injury or temporary displacement to any cetacean species. Therefore, there is unlikely to be a transboundary impact from the noise generated by the proposed decommissioning operations at VDP1 and LDP1 areas.

The infrastructure to be decommissioned at VDP1 and LDP1 is located in the SNS gas basin which is currently home to 177 installations, eight of which are currently listed as un-operational (Section 4; DECC, 2014a). Nevertheless, the closest fields are the

Brigantine A, B, C and D Fields (including 10 platforms) which are located to the east south east of the Viking B Field (21 km at the closest point) and the Leman Field (including 33 platforms) is located 4 km to the south of the Vulcan Field.

Given the location of the proposed works, and the limited impact of VDP1 and LDP1 noise decommissioning activities, no cumulative impacts (resulting from cumulative sound sources) are anticipated with other oil and gas installations or fields.

In addition, VDP1 and LDP1 facilities to be decommissioned are located (at their closest point) 32 km south of the Hornsea Wind Farm Zone and 42 km northwest of the East Anglia Wind Farm Zone (Section 4). Considering the limited impact of VDP1 and LDP1 noise decommissioning activities, no cumulative impacts are anticipated with wind farms.

There is a possibility for future aggregate extraction within the SCI; however the associated cumulative impact would be limited. 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 mention that the elevated broadband noise is dependent on the aggregate type being extracted (gravel generating higher noise levels than sand) (MALSF, 2011). In addition, due to the limited impact of vessel noise highlighted by the noise modelling assessment, no cumulative impacts from aggregate extraction activity would be expected.

8.6 Mitigation Measures

Appropriate mitigation measures, in accordance with the relevant JNCC guidelines (2010b), should be implemented during the proposed decommissioning operations (Table 8.7). Noise generated from vessel activities are generally not considered by JNCC (2010b) 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 (BMT Cordah, 2014c). Consequently, it is considered unlikely that mitigation measures will be required beyond those listed in Table 8.7.

Table 8.7: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Underwater noise from decommissioning activities	• Machinery and equipment will be in good working order and well-maintained. • Helicopter maintenance will be undertaken by contractors in line with manufacturers and regulatory requirements. • The number of vessels utilising Dynamic Positioning would be minimised where possible, taking into mitigation proposed for other receptors.

8.7 Conclusions

Sound levels associated with the decommissioning operations of VDP1 and LDP1 facilities 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 VDP1 and LDP1 areas across the year. Grey and common seals have been recorded (5

km x 5 km grid) in densities of 0 to 5 and 0 to 50 animals, respectively. These species are all subject to regulatory protection from injury and disturbance.

A worst-case scenario for the modelling of underwater vessels noise has been undertaken considering one point source location and eight vessels. This represents the maximum vessel number that may be at VDP1 and LDP1 areas 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 its immediate vicinity or by any other continuous noise source during the offshore decommissioning activities at VDP1 and LDP1 areas. The individual and cumulative impacts from decommissioning activity at VDP1 and LDP1 are not considered significant.

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9.0 SEABED IMPACTS

This section discusses the potential short and long-term environmental impacts associated with seabed disturbance resulting from the proposed VDP1 and LDP1 decommissioning activities. The measures planned by ConocoPhillips to minimise these impacts are detailed in Section 9.6.

9.1 Regulatory Context

Seabed disturbance resulting from the proposed VDP1 and LDP1 decommissioning activities will be managed in accordance with current legislation and standards as detailed within Appendix A.

9.2 Approach

VDP1 and LDP1 include the decommissioning of eight platform jackets, one T-piece, 16 pipelines and associated mattresses and grout bags. These activities will require work below, at, or near the seabed which may result in short-term or long-term disturbance to seabed sediments and background sediment concentrations.

Table 9.1 summarises the short and long-term environmental impacts associated with seabed disturbance during the proposed VDP1 decommissioning activities, while Table 9.2 summarises the short and long-term environmental impacts associated with seabed disturbance during the proposed LDP1 decommissioning activities.

Table 9.1: Summary of potential sources of seabed disturbance and resultant environmental impacts during VDP1

Decommissioning activity outcome	Seabed sediment environmental Impact		
	Release of contaminants	Burial and smothering	Change in habitat
Presence of the pipelines and mattresses decommissioned *in situ*	Long-term	-	-
Full removal of topsides	Not applicable		
Full removal of jackets	-	Short-term	-
Rock-placement over pipeline ends	-	Long-term	Long-term
Rock-placement (rock berms) for AWV support	-	Long-term	Long-term
Anchoring activities	-	Short-term	-

Table 9.2: Summary of potential sources of seabed disturbance and resultant environmental impacts during LDP1

Decommissioning activity outcome	Seabed sediment environmental Impact		
	Release of contaminants	Burial and smothering	Change in habitat
Presence of the pipelines and mattresses decommissioned *in situ*	Long-term	-	-
Full removal of topsides	Not applicable		
Full removal of jackets	-	Short-term	-
Removal of T-piece	-	Short-term	-
Rock-placement over pipeline ends	-	Long-term	Long-term
Rock-placement (rock berms) for AWV support	-	Long-term	Long-term
Anchoring activities	-	Short-term	-

The proposed VDP1 and LDP1 activities will also require the operation of a jack-up AWV. Vessels with DP capability will be used as a priority where noise is not deemed to be an issue. However, anchors may be required to support vessels carrying out heavy lifting operations, such as the removal of the topsides and jacket by HLV. The magnitude of impacts arising from the VDP1 and LDP1 activities are described separately in the sections that follow.

9.3 Sources of Potential Impacts

The following VDP1 activities represent worst-case scenarios and will require work at, below or near the seabed:

- Cutting operations below the seabed for the five jackets to allow full removal, including potential excavation activities to enable access for a Remotely Operated Vehicle (ROV) and/ or cutting tool (short-term impact);
- Anchoring of a HLV during lifting activities (short-term impact);
- Excavation and rock-placement below and on the seabed to cover pipeline ends (long-term impact);
- Rock-placement to support positioning of a jack-up AWV at seven platform locations (not including the contingency application for 1,000 tonnes of rock should scour be experienced whilst on location at the Vulcan UR platform) (long-term impact);
- Decommissioning the ten pipelines and associated mattresses/ grout bags *in situ* (long-term impact); and
- 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, NORM scale and any entrained heavy metals and any hydrocarbons or heavy metals associated with residual solids.

Structures and materials to be removed or deposited as part of VDP1 and the approximate seabed area of disturbance are presented in Table 9.3.

The following LDP1 activities represent worst-case scenarios and will require work at, below or near the seabed:

- Cutting operations below the seabed for the three jackets to allow full removal, including potential excavation activities to enable access for an ROV and/ or cutting tool (short-term impact);
- Anchoring of a HLV during lifting activities (short-term impact);
- Cutting operations and possible excavation below the seabed for the T-piece to allow full removal (short-term impact);
- Excavation and rock-placement below and on the seabed to cover exposed pipeline ends (long-term impact);
- Rock-placement to support positioning of a jack-up AWV at seven platform locations (long-term impact);
- Decommissioning the three pipelines and associated mattresses/ grout bags *in situ* (long-term impact); and
- 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, NORM scale and any entrained heavy metals and any hydrocarbons or heavy metals associated with residual solids.

Structures and materials to be removed or deposited as part of LDP1 and the approximate seabed area of disturbance are presented in Table 9.4. As previously discussed, the decommissioning programme will leave the pipelines *in situ* and result in the release of chemical contaminants as the steel pipelines, their coatings and any residual scale degrades.

9.3.1 Jacket removal

As the weight (in air) of the VDP1 and LDP1 jackets are <10,000 tonnes, they fall within the OSPAR 98/3 category of steel structures for which derogation cannot be sought. Therefore the only option available for these eight platforms is full removal, as presented in Section 3.

VDP1 jacket removal

The piles on all five jackets will be removed to approximately 3 m below the seabed and should be suitable for removal via internal cutting methods. However, access will only be confirmed when internal camera inspections are completed for all platforms. The excavation of an area around each jacket pile has therefore been considered here as a worst-case scenario. Sediment will be excavated by a work class ROV and will be deposited down-current of the jacket piles, where it will undergo natural dispersal with minimal/ short-term impact on surrounding seabed area.

If excavation of the footings is needed, removal of the five jackets under VDP1 will impact a maximum seabed area of, approximately, 0.0064 km^2 (Table 9.3). Due to the proximity of the excavation it is there may be some overlap in the sediment deposition and this footprint is therefore an overestimate. However due to the dynamic nature of the seabed in this area dispersion of the sediment is expected to be rapid.

Table 9.3: Structures and materials with the potential to impact on the seabed as part of VDP1 – Jacket removal

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Viking CD	154 m^2 x 12 piles	0.0019	0.00005	Indefatigables (1 km)
Viking DD	154 m^2 x 8 piles	0.0012	0.00003	Indefatigables (<1 km)
Viking ED	154 m^2 x 8 piles	0.0012	0.00003	Swarte Bank (1.5 km)
Viking GD	154 m^2 x 6 piles	0.0009	0.00003	Indefatigables (1.3 km)
Viking HD	154 m^2 x 8 piles	0.0012	0.00003	Indefatigables (3.5 km)
Jacket removal total		*0.0064*	*0.00018*	

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

The cut jackets will be removed from the seabed in a single lift and transported to shore by HLV or SLV for dismantlement, disposal and recycling. The VDP1 jacket removal operations are scheduled to commence in Q3 2015, with each removal operation expected to take approximately two weeks.

LDP1 jacket removal

All three jackets will be removed to approximately 3 m below the seabed and all but the Vulcan UR are known to be suitable for removal via internal cutting methods. However, access to the Vampire OD and Viscount VO will be confirmed when internal camera inspections are completed. Again, the excavation of an area around each jacket pile has

therefore been considered here as a worst-case scenario. Sediment will be excavated by a work class ROV and will be deposited down-current of the jacket piles, where it will undergo natural dispersal with minimal/ short-term impact on surrounding seabed area.

Excavation prior to removal of the three jackets under LDP1 will impact a maximum seabed area of, approximately, 0.0018 km^2 (Table 9.4).

Table 9.4: Structures and materials with the potential to impact on the seabed as part of LDP1 – Jacket removal

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Viscount VO	154 m^2 x 4 piles	0.0006	0.000017	Swarte Bank (2.5 km)
Vampire OD	154 m^2 x 4 piles	0.0006	0.000017	Swarte Bank (2 km)
Vulcan UR	154 m^2 x 4 piles	0.0006	0.000017	Inner Bank and Well Bank (both 2.5 km)
Jacket removal total		*0.0018*	*0.000051*	

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

The cut jackets will be removed from the seabed in a single lift and transported to shore by HLV or SLV for dismantlement, disposal and recycling. The LDP1 jacket removal operations are scheduled to commence in Q2 2017, with each removal operation expected to take approximately two weeks.

9.3.2 T-piece removal

The recommended option for decommissioning the T-piece under LDP1 is the full removal as outlined in Section 3 with associated lifting operations.

Removal of the T-piece (and protective structure) along with associated mattresses and grout bags, will impact a seabed area of approximately 1.1 x 10^{-4} km^2, accounting for 3 x 10^{-6} % of the area of the North Norfolk Sandbanks and Saturn Reef SCI (Table 9.5). The structure will be lifted onto a DSV and the operations are expected to take approximately four days.

Table 9.5: Structures and materials with the potential to impact on the seabed as part of LDP1 – T-piece removal

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
T-piece	11 m x 10 m	0.0001	0.000003	Swarte Bank (2 km)
T-piece removal total		*0.0001*	0.000003	

Note: T-piece with protective structure.

9.3.3 Anchoring of lifting vessel(s)

ConocoPhillips anticipate that a SLV or HLV that requires anchors to maintain its position may be required during the proposed lifting activities. The vessel contract has yet to be awarded, but depending on the lifting contractor there may be an option to lift the topside and jacket in a single lift operation. However to calculate a worst-case anchoring scenario, calculations have been based on:

- HLV vessel operation with a maximum eight point mooring system;
- Two vessel operations at each platform location (jacket and topside lifts);

- Anchor dimensions of 4.1 x 4.8 m, (based on a 10-tonne (10,000 kg) 'flipper delta' anchor); and
- A chain length of 1,250 m, a maximum seabed contact length of 975 m and an average chain width of 0.076 m.

Anchoring the AWV at the five VDP1 platform locations, will impact a total seabed area of, approximately, 0.0038 km^2 (Table 9.6).

Table 9.6: Structures and materials with the potential to impact on the seabed as part of VDP1 – Anchoring of HLV

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Anchor	(4.1 m x 4.8 m) x 8 anchors x 5 locations	0.0008	0.00002	As above for platforms (Table 9.3)
Chain	(975 m x 0.076 m) x 8 anchors x 5 locations	0.0030	0.00008	As above for platforms (Table 9.3)
Anchoring total		*0.0038*	*0.00010*	

Note: Anchoring assumptions based on:

- Dimensions based on a 10-tonne (10,000 kg) 'flipper delta' anchor.
- Total chain length 1,250 m and a maximum contact length of 975 m, with an average chain width of 76 mm (0.076 m).
- Eight point anchoring HLV at five platform sites. For the purposes of measuring to sandbanks the location has been assumed to be the same as the platform location.
- Two anchoring events accounting for two lifts, one for the topsides and one for the jacket.

Anchoring the AWV at the three LDP1 platform locations will impact a total seabed area of, approximately, 0.0023 km^2 (Table 9.7).

Table 9.7: Structures and materials with the potential to impact on the seabed as part of LDP1 – Anchoring of HLV

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Anchoring of HLV[2]				
Anchor	(4.1 m x 4.8 m) x 8 anchors x 3 locations	0.0005	0.00001	As above for platforms (Table 9.4)
Chain	(975 m x 0.076 m) x 8 anchors x 3 locations	0.0018	0.00005	As above for platforms (Table 9.4)
Anchoring total		*0.0023*	*0.00006*	

Note: Anchoring assumptions based on:

- Dimensions based on a 10-tonne (10,000 kg) 'flipper delta' anchor.
- Total chain length 1,250 m and a maximum contact length of 975 m, with an average chain width of 76 mm (0.076 m).
- Eight point anchoring HLV at five platform sites. For the purposes of measuring to sandbanks the location has been assumed to be the same as the platform location.
- Two anchoring events accounting for two lifts, one for the topsides and one for the jacket.

9.3.4 Rock-placement on decommissioned pipelines

As part of pipeline decommissioning, an estimated 5 m will be removed from the satellite ends of each VDP1 and LDP1 pipelines (i.e., adjacent to each satellite platform), leaving some of the pipeline exposed. Where required, sediment will be excavated by a work

class ROV and will be deposited down-current of the pipeline ends, where it will undergo natural dispersal with minimal/ short-term impact on surrounding seabed area.

ConocoPhillips intends to place rock over the cut pipeline ends producing a tapered berm. Where the pipeline is on the seabed and is not buried, the berm will be produced based on a 3:1 profile providing a burial depth over the top of the pipeline to at least 0.6 m. This tapered rock berm will have an estimated footprint of 1.8×10^{-5} km^2. The estimated worst-case mass of rock-placement required for the burial of each cut pipeline end is 25 tonnes, this is based on an average of 16.2 tonnes and a 50% contingency to account for variation at each of the locations.

Where pipelines ends are already buried, the intention would be to excavate to allow access for the cut, the pipeline end would then be covered to a height of 0.6 m above the top of the pipeline and any remaining trench would be left to naturally backfill. This is expected to occur in a relatively short time as a result of the dynamic seabed conditions present across the decommissioning areas.

VDP1 decommissioned pipelines

The recommended option for decommissioning the 10 infield pipelines *in situ*, under VDP1 is to place a maximum of 25 tonnes of graded rock over of the pipeline ends, adjacent to the satellite platforms. Existing stabilisation features (mattresses, grout bags and rock-placement) will be decommissioned *in situ* to minimise the amount of additional rock-placement required. Approximately 125 tonnes of rock will be required to provide sufficient cover for all five of the VDP1 gas pipelines and their piggybacked methanol lines (five pipeline ends) and will result in an approximate footprint of 0.0001 km² (Table 9.8).

Table 9.8: Structures and materials with the potential to impact on the seabed as part of VDP1 – Pipeline rock-placement

Material	Quantity/ Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Rock on pipeline ends	25 tonnes x 5 sites/ 18 m^2 x 5 cuts	0.0001	0.000003	As above for platforms (Table 9.3)
Pipeline rock-placement total		0.0001	0.000003	

Note: ConocoPhillips estimate 25 tonnes of rock will be required at each pipeline end.

LDP1 decommissioned pipelines

The recommended option for decommissioning the six infield pipelines *in situ*, under LDP1 is to place approximately 25 tonnes of graded rock over each cut pipeline end. Existing stabilisation features (mattresses, grout bags and rock-placement) will be decommissioned *in situ* to minimise the amount of additional rock-placement required. There will be a total of six cut pipeline ends at LDP1 requiring rock-placement as a result of removing the platforms and T-piece. This equates to approximately 175 tonnes of rock being required to provide sufficient cover for the six LDP1 gas pipelines and their piggybacked methanol lines (six pipeline ends) and will result in an approximate footprint of 1.08×10^{-4} km^2 (Table 9.9).

Table 9.9: Structures and materials with the potential to impact on the seabed as part of LDP1 – Pipeline rock-placement

Material	Quantity/ Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Rock on pipeline ends	25 tonnes x 6 sites/ 18 m^2 x 6 cuts	0.0001	0.000003	As above for platforms (Table 9.4)
Pipeline rock-placement total		0.0001	0.000003	

Note: ConocoPhillips estimate 25 tonnes of rock will be required at each pipeline end.

9.3.5 Stabilisation of the accommodation work vessel

It is anticipated that stabilising rock berms will be required to provide extra support for the AWVs jack-up legs when working at seven of the eight platform locations. The rock will be placed at four adjoining locations on the seabed as rock berms to support the four AWV jack-up legs.

The amount of rock required (and therefore footprint) is dependent on local bathymetry and sediment structure at each platform site. Site specific assessments are currently ongoing (Table 3.24; Section 3.8).

A direction for deposits application will be submitted to the DECC to seek approval for the commencement of the rock-placement operations at each platform location. The volume of rock and site specific berm design will be detailed within each application, and will be based on the final SSA results for each platform location.

AWV stabilisation for the VDP1

Based on SSA results to date and the worst case mass (34,000 tonnes) assumed to be required at Viking CD where the SSA is yet to be finalised, ConocoPhillips estimate the worst case mass of rock that will be required at the five VDP1 locations will be 135,500 tonnes. ConocoPhillips estimate that 0.035 km^2 of the seabed will be impacted from the installation of the rock berms at the five VDP1 platform locations (Table 9.10).

Table 9.10: Structures and materials with the potential to impact on the seabed as part of VDP1 – AWV rock-placement

Material	Quantity/ Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Rock for AWV support at Viking CD	34,000 tonnes	0.0079	0.00022	As above for platforms (Table 9.3)
Rock for AWV support at Viking DD	22,500 tonnes	0.0063	0.00017	As above for platforms (Table 9.3)
Rock for AWV support at Viking ED	20,000 tonnes	0.0061	0.00017	As above for platforms (Table 9.3)
Rock for AWV support at Viking GD	25,000 tonnes	0.0066	0.00018	As above for platforms (Table 9.3)
Rock for AWV support at Viking HD	34,000 tonnes	0.0079	0.00022	As above for platforms (Table 9.3)
AWV rock-placement total		*0.0348*	*0.00096*	

Note: Dimensions of rock berms and quantities of rock required for each of the platforms are site-specific, (Section 3.8). Worst case rock berm estimate (Viking HD) used for the locations at which the SSAs are yet to be finalised (Viking CD, Viscount VO and Vampire/ Valkyrie OD) to ensure that a worst case impact is presented.

AWV stabilisation for the LDP1

For LDP1 platforms the SSA has been completed for the Vulcan UR platform. No rock is required to safely locate the AWV however a contingency quantity of 1,000 tonnes has been assumed to allow for remediation works should scour be encountered whilst the vessel is on location. As the SSAs for the Viscount VO and Vampire/ Valkyrie OD platforms are to be completed, the worst case berm design and rock-placement quantity at Viking HD (34,000 tonnes) has been assumed. ConocoPhillips estimate the worst case mass of rock that will be required at the three LDP1 locations will be 69,000 tonnes. ConocoPhillips estimate that 0.017 km^2 of the seabed will be impacted from the installation of the rock berms and scour remediation material at the three LDP1 platform locations (Table 9.11).

Table 9.11: Structures and materials with the potential to impact on the seabed as part of LDP1 – AWV rock-placement

Material	Quantity	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
Rock for AWV support at Viscount VO	34,000 tonnes	0.0079	*0.00022*	As above for platforms (Table 9.4)
Rock for AWV support at Vampire OD	34,000 tonnes	0.0079	*0.00022*	As above for platforms (Table 9.4)
Rock for AWV support at Vulcan UR	1,000 tonnes	0.0011	*0.00003*	As above for platforms (Table 9.4)
AWV rock-placement total		*0.0169*	*0.00047*	

Note: Dimensions of rock berms and quantities of rock required for each of the platforms are site-specific, (Section 3.8). Worst case rock berm estimate (Viking HD) used for the locations at which the SSAs are yet to be finalised (Viking CD, Viscount VO and Vampire/ Valkyrie OD) to ensure that a worst case impact is presented.

9.3.6 Structures decommissioned *in situ*

Following the removal of 5 m of pipelines from each of the cut ends, the remaining VDP1 and LDP1 pipelines and associated pipeline support materials will be decommissioned *in situ.* The approximate area of seabed affected by decommissioning the ten pipelines (and any stabilisation materials) *in situ* at the VDP1 site is estimated to be 0.306 km^2 (Table 9.12).

Table 9.12: Structures and materials with the potential to impact on the seabed as part of VDP1 – Structures (pipelines and associated stabilisation features) decommissioned *in situ*

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
PL0089 & PL0132	3,880 m x 10 m	0.0388	0.0011	All of the VDP1 pipelines cross the Indefatigables sandbank complex to some degree. The estimated total distance crossed is approximately12 km.
PL0090 & PL0131	4,080 m x 10 m	0.0408	0.0011	
PL0091 & PL0133	11,980 m x 10 m	0.1198	0.0033	
PL0092 & PL0066	5,080 m x 10 m	0.0508	0.0014	
PL0093 & PL0130	5,580 m x 10 m	0.0558	0.0016	
Structures decommissioned in situ total		*0.3060*	*0.0085*	

Note: Dimensions are estimated based on a 10 m wide pipeline corridor accounting for the presence of the piggybacked methanol pipeline and any pipeline stabilisation features. The pipeline ends to be removed (5 m length at each cut end) have been subtracted from the length of each pipeline.

The approximate area of seabed affected by decommissioning the six pipelines (and any stabilisation materials) *in situ* at the LDP1 site is estimated to be 0.24 km^2 (Table 9.13).

Table 9.13: Structures and materials with the potential to impact on the seabed as part of LDP1 – Structures (pipelines and associated stabilisation features) decommissioned *in situ*

Structure	Dimensions	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Approximate distance (km) and name of nearest sandbank within SCI
PL0462 & PL0463	3,680 m x 10 m	0.0368	0.0010	Well Bank (1 km)
PL1692 & PL1693	8,980 m x 10 m	0.0898	0.0025	2 km of pipeline cross the Broken Bank
PL1962 & PL1963	11,280 m x 10 m	0.1128	0.0031	Swarte Bank (2 km)
Structures decommissioned in situ total		*0.2394*	*0.0066*	

Note: Dimensions are estimated based on a 10 m wide pipeline corridor accounting for the presence of the piggybacked MeOH pipeline and any pipeline stabilisation features. The pipeline ends to be removed (5 m length at each cut end) have been subtracted from the length of each pipeline.

9.4 Short and Long-Term Impacts

The seabed impacts resulting from the decommissioning activities associated with VDP1 and LDP1 can be classified as short or long-term. Short-term impacts can be defined as those which have transient impacts lasting a few days to a few years. Long-term impacts are those which will continue to have an impact for decades to centuries following decommissioning.

9.4.1 Short-term impacts

Cutting, excavation and anchoring activities will be transient and will have a short-term impact on the local benthic environment in the VDP1 and LDP1 areas. The likely short-term impacts arising from these activities can be summarised as:

- Sediment disturbance (Section 9.5.1); and
- Fauna disturbance (Section 9.5.2).

9.4.2 Long-term impacts

Long-term seabed impacts relate to the presence and physical/ chemical breakdown of the *in situ* pipelines, mattresses, grout bags and rock-placement over pipeline ends and as rock berms for AWV support. The likely long-term impacts arising from these activities can be summarised as:

- Habitat change (Section 9.6.1.3).
- Seabed morphological change (Section 9.6.2); and
- Fauna disturbance (Section 9.6.3).

9.5 Short-Term Impacts on Sensitive Receptors

The following sections provide an overview of the current understanding of the seabed environment in the North Norfolk Sandbanks and Saturn Reef SCI, enabling an assessment to be made of the spatial and temporal extent of the short- term impacts.

9.5.1 Sediment disturbance

This dynamic seabed environment of the North Norfolk Sandbanks and Saturn Reef is characterised by large and small sand waves, megaripples, and small exposed shoal areas. The dynamic nature of the seabed is also indicated by a number of existing features of the seabed, including:

- Areas of scour around oil and gas structures and the wrecks observed during the 2013 surveys (Section 4);
- The silt and clay content of the seabed sediments, which is restricted to less than 15% (Fugro, 2014a and 2014b); and
- The redistribution of drill cuttings piles from around wellheads in the vicinity of the VDP1 and LDP1 installations.

VDP1 sediments

As described in Section 4, sediments within the VDP1 area were classified as very poorly to moderately well sorted, fine sand to fine gravel. The silt/ clay and organic matter content across the sampling stations around the VDP1 facilities was low, less than 15% (Fugro, 2014a and 2014b).

The decommissioning environmental surveys undertaken around the VDP1 facilities suggest that the THC range from 0.5 to 3.3 $\mu g g^{-1}$ and are lower than background levels recorded during SNS environmental surveys undertaken between 1975 and 1995 (Section 4; Table 4.2; Fugro, 2014a). Concentrations of metals in the VDP1 area sediments were found to be relatively constant throughout the survey area, and within the range of natural background concentrations for the region (Section 4; Table 4.2; Fugro, 2014a).

LDP1 sediments

The sediments in the LDP1 area were classified as very poorly to moderately well sorted, coarse to fine sands (Section 4). The silt/ clay and organic matter content across the sampling stations around the VDP1 facilities was low, less than 15% (Fugro, 2014a and 2014b).

THC measured during the LDP1 decommissioning environmental surveys were found to be predominantly lower THC levels than previously recorded in the area, and lower than or similar to, the average background concentration calculated from environmental survey data collected between 1975 and 1995 in the SNS (Table 4.2; Section 4) (Fugro, 2014b). Metal concentrations recorded within the LDP1 sediments were relatively constant throughout the survey areas and were within ranges measured at other locations during the environmental baseline surveys (Fugro, 2014b). Metal concentrations observed within the LDP1 survey data were within the range of natural background concentrations (Table 4.2; Section 4) (Fugro, 2014b).

VDP1 and LDP1 sediment impact and recovery

Removal of the T-piece, excavation around the jacket legs from the seabed, excavation at the pipeline ends, and anchoring of lifting vessels, will physically disturb the sediment in the local area. The disturbance to benthic fauna will be short-term, localised and confined to an estimated area of impact of 0.0102 km^2 for VDP1 (Table 9.14) and 0.0042 km^2 for LDP1 (Table 9.15). For VDP1 this will be 0.0003% and for LDP1 this will be 0.0001% of the total area of the SCI (3,603.41 km^2).

Table 9.14: Structures and materials with the short-term potential to impact on the seabed as part of VDP1

Structures and materials with the short-term potential to impact on the seabed as part of VDP1	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Table reference
Jacket removal total	*0.0064*	*0.0002*	Table 9.3
Anchoring total	*0.0038*	*0.0001*	Table 9.6
Total VDP1 seabed impact	***0.0102***	***0.0003***	

Table 9.15: Structures and materials with the short-term potential to impact on the seabed as part of LDP1

Structures and materials with the short-term potential to impact on the seabed as part of LDP1	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Table reference
Jacket removal total	*0.0018*	*0.00005*	Table 9.4
T-piece removal total	*0.0001*	*0.00000*	Table 9.5
Anchoring total	*0.0023*	*0.00006*	Table 9.7
Total LDP1 seabed impact	***0.0042***	***0.00011***	

Sediments that are redistributed and mobilised as a result of the proposed VDP1 and LDP1 decommissioning activities will be transported by the seabed currents before settling out over adjacent seabed areas. The dynamic marine environment (Section 4) in this area will result in suspended sediment, in particular the fines, being transported away from the source of the disturbance. The natural settling of the suspended sediments is such that the coarser material (sands) will primarily fall out of suspension with the finer material being the last to settle. This natural process will ensure that all the suspended sediment is not deposited in one location. Based on the mobility of the seabed in the area, as indicated by the lack of drill cuttings piles around wellheads within the SCI (Section 4), the deposition resulting from the VDP1 and LDP1 decommissioning activities is likely to be comparable to the background sediment redistribution processes.

In such a high energy area, the expected sediment recovery time from dredging activities is approximately eight months. For example, areas of dredging on sandbanks which are subject to naturally high sediment mobility may disappear within a few tidal cycles (Hill *et al.,* 2011). 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 the large waves have the capability to mobilise seabed sediments, increasing sediment suspension particularly for those sizes of coarse sands and smaller (ABPmer, 2012).

Long-term analysis at the Sean Gas Field in Block 49/25a (Thompson *et al*., 2011) suggests that wave conditions are strong enough to re-suspend medium sand all year round, with peaks indicating re-suspension 51% and 60% of the time in January and March, and generally increased potential re-suspension in the winter months from September to March. Following completion of the proposed VDP1 and LDP1 activities, the natural physical processes of sediment transportation and natural backfilling are therefore expected to restore the seabed habitat to its equilibrium state within a year.

9.5.2 Fauna disturbance

Fauna living on and around the sediment are typical for this area of the SNS. Fauna specific to the VDP1 and LDP1 areas are identified below.

VDP1 fauna

As described in Section 4, benthic fauna species identified during the survey of the VDP1 area are typical for the general area, sediment type and water depth. The polychaetes *Ophelia borealis*, *Nephtys cirrosa*, several species of *Spio* and crustacean from the genera *Bathyporeia* and *Urothoe,* all typical of the mobile sand and coarser sediments present across the SNS area, were identified (Fugro, 2014a and 2014b).

The VDP1 facilities are located within spawning grounds for mackerel, cod, whiting, plaice, lemon sole, sole, sandeel, sprat and *Nephrops* (Section 4).

LDP1 fauna

As detailed in Section 4, benthic fauna species identified during the survey of the LDP1 area are typical for the general area, sediment type and water depth. The polychaetes *Ophelia borealis*, *Nephtys cirrosa*, several species of *Spio* and crustacean from the genera *Bathyporeia* and *Urothoe,* all typical of the mobile sand and coarser sediments present across the SNS area were identified (Fugro, 2014a and 2014b). Epifaunal communities were sparse. The benthic community at the Vulcan platform station was found to be dominated by species associated with fine sands and muds, namely *Mediomastus fragilis*, *Goniada maculata*, *Galathowenia oculata*, *Anobothrus gracilis* and molluscs (*Kurtiella bidentata* and *Abra alba*).

The LDP1 facilities are located within spawning grounds for mackerel, cod, whiting, plaice, lemon sole, sole, sandeel, sprat and *Nephrops* (Section 4).

VDP1 and LDP1 fauna impact and recovery

Removal of the T-piece and jackets from the seabed, and the anchoring of lifting vessels will physically disturb the benthic fauna living on or in the sediment in the localised area. The disturbance to benthic fauna will be localised, confined to an estimated area of impact of 0.0102 km^2 for VDP1 (Table 9.14) and 0.0042 km^2 for LDP1 (Table 9.15). For VDP1, this amounts to 0.0003% and for LDP1 this amounts to 0.0001% of the total area of the SCI (3,603.41 km^2).

The proposed VDP1 and LDP1 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 ceased. 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 VDP1 area) had the most rapid recovery rate following disturbance.

Studies of seabed dredging sites indicate that faunal recovery times are generally proportional to the spatial scale of the impact (where the impact is between 0.1 m^2 and 0.1 km^2 (Foden *et al.,* 2009)). Biological recovery is therefore expected to be even quicker in less extensive, dynamic sandy habitats (Hill *et al.,* 2011) such as those observed at the VDP1 and LDP1 sites. In low-energy areas of the North Sea subject to extensive dredging, local fauna took approximately three years to recover to the original

level of species abundance and diversity. Studies of the impacts from anchoring indicate that the faunal recovery from the processes of anchor scarring, anchor mounds and cable scrape is likely to be relatively rapid (1 to 5 years) (DECC, 2011b). Based on the dynamic characteristics of the seabed in the VDP1 and LDP1 areas, recovery would be expected to be at the lower end of this scale.

A small number of demersal and pelagic fish and their spawning grounds might also be temporarily disturbed by the removal of the structures. However, fish are highly mobile organisms and are likely to avoid areas of re-suspended sediments and turbulence during the activities. The potential release of contaminants from the sediments may affect the early life stages of some fish species. However, both metal and THC concentrations in the VDP1 and LDP1 area sediments are within background levels (Fugro, 2014a and 2014b) and the proposed activities will be localised. Therefore the proposed activities are unlikely to have an impact on species populations or their long-term survival.

9.6 Long-term Impacts on Sensitive Receptors

The following sections describe the footprint of the existing pipelines and supporting materials within the VDP1 and LDP1 areas and the additional footprint that could be created due to the introduction of further rock-placement.

9.6.1 Habitat change

Habitat change will result from the introduction of hard substrate (rock-placement) into a predominantly soft substrate environment.

VDP1 habitat

The VDP1 pipelines and mattresses are located in an area of the SNS where the sediment comprises fine to coarse sands, often silty and with variable amounts of shell fragments and occasional pebbles and cobbles (Section 4.2).

The VDP1 infrastructure is located within the North Norfolk Sandbanks and Saturn Reef SCI (Section 4; JNCC, 2014a). Annex I habitats occurring within this SCI include sandbanks that radiate northeast parallel to the Norfolk coast. Also present are Annex I biogenic reef habitats formed by the polychaete worm *S. spinulosa* (Table 4.1). *S. spinulosa* was identified in several historical survey reports within and adjacent to the areas containing VDP1 infrastructure (Conoco, 1998 and 2002; ConocoPhillips, 2005 and 2008; Venture, 2006). The reviewed reports indicated that a series of small patches of *S. spinulosa* were observed on an otherwise fine sand environment to the west of the Viking ED platform, however these aggregations were limited and did not elevate above the seabed surface (BMT Cordah, 2014b). Consequently, they did not constitute a *S. spinulosa* reef as defined by JNCC (Gubbay, 2007)

LDP1 habitat

The LDP1 pipelines and mattresses are located in an area of the SNS where the sediments comprise fine to coarse sands, often silty and with variable amounts of shell fragments and occasional pebbles and cobbles (Section 4.2).

The LDP1 infrastructure is also located within the North Norfolk Sandbanks and Saturn Reef SCI (Section 4; JNCC, 2014a). Annex I habitats occurring within this SCI include open shelf linear sandbanks that radiate northeast parallel to the Norfolk coast. Also present are Annex I biogenic reef habitats formed by the polychaete worm *S. spinulosa*

(Table 4.1). *S. spinulosa* were identified in several historical survey reports within and adjacent to the areas containing LDP1 infrastructure (Conoco, 1998 and 2002; ConocoPhillips, 2005 and 2008; Venture, 2006). Indications from the reviewed reports show that there is a high probability of *S. spinulosa* across the region even though these most recent surveys did not observe sections of *S. spinulosa* habitat (BMT Cordah, 2014b).

VDP1 and LDP1 impact and recovery

The proposed rock-placement over the pipeline ends for the ten (piggybacked) pipelines in the VDP1 area and the placement of rock berm support for the AWV adjacent to the five VDP1 platforms will result in a modification of the substrate and habitat type in the local area (0.035 km^2; Tables 9.8 and 9.10) that is not likely to constitute a significant impact. This represents a small proportion (approximately 0.001%) of the total area of the North Norfolk Sandbanks and Saturn Reef SCI which has a seabed area of 3,603 km^2.

The decommissioning of the VDP1 mattresses and grout bags *in situ* will reduce the amount of additional material needed to be introduced into the SCI. If these were to be removed, further stabilisation material (rock-placement) would need to be added to the pipelines to ensure the stability and burial of the pipelines is maintained in this highly dynamic marine environment. Based on a berm width of 12 m (to enable coverage of the mattress area and to incorporate a 3:1 slope), this would equate to approximately 572 tonnes of additional rock-placement within the SCI with a footprint of 0.00216 km^2. Further to this, the impact of removing the 30 (6 m x 3 m) mattresses currently *in situ* at VDP1 would disturb a minimum of 5.4 x 10^{-4} km^2 of overlying sediment.

The proposed rock-placement over the pipeline ends for the six (piggybacked) pipelines in the LDP1 area and the placement of the rock berm support for the AWV adjacent to the two LDP1 platforms and contingency rock at the one LDP1 platform will result in a modification of the substrate and habitat type in the local area (0.024 km^2; Tables 9.7 and 9.9) that is not likely to constitute a significant impact. This represents a small proportion (approximately 0.0007%) of the total seabed area, (3,603 km^2) of the North Norfolk Sandbanks and Saturn Reef SCI.

The decommissioning of the LDP1 mattresses *in situ* will reduce the amount of additional material needed to be introduced into the SCI. If these were to be removed, further stabilisation material (rock-placement) would need to be added to the pipelines to ensure the stability and burial of the pipelines is maintained in this highly dynamic marine environment. Based on a berm width of 12 m (to enable coverage of the mattress area and to incorporate a 3:1 slope) this would equate to approximately 2,422 tonnes of additional rock-placement within the SCI with a footprint of 0.00914 km^2. Further to this, the impact of removing the 97 (6 m by 3 m) mattresses currently *in situ* at LDP1 would disturb a minimum of 0.001746 km^2 of overlying sediment.

The existing mattress protection over the pipelines will remain *in situ* as part of the VDP1 and LDP1 programmes. As organisms associated with hard substrates will be naturally present in the area, the mattresses and areas of rock-placement provide a relatively small additional rocky habitat for epibenthic organisms. The seabed feature that will result from the rock-placement may also provide habitats for crevice-dwelling fish (e.g., ling, conger eel and wolf fish) and crustaceans (e.g., squat lobsters and crabs) and may attract fish species to the site (Lissner *et al.,* 1991).

9.6.2 Seabed morphological change

Morphological change of the seabed in the VDP1 and LDP1 areas (further to the natural seabed dynamics evident in these areas) may result from the presence of the pipelines and associated protection material decommissioned *in situ* and rock placed on the seabed to provide support for the AWV jack-up legs. This section outlines the footprint remaining in both areas due to the decommissioning of this infrastructure *in situ,* the placement of the rock and analyses the potential for this infrastructure to contribute to morphological change. Morphological change is discussed in context with current knowledge of seabed dynamics in the North Norfolk Sandbanks and Saturn Reef SCI, which is designated for the presence of Annex I sandbanks and biogenic reefs.

VDP1 footprint

The footprint resulting from leaving the pipelines and associated supporting material *in situ* in the VDP1 area is estimated to be 0.306 km^2 (Table 9.16), representing 0.0085% of the area of the North Norfolk Sandbanks and Saturn Reef SCI (3,603 km^2). The introduction of rock (to cover pipeline ends and as support for the AWV) to the VDP1 area will increase the long-term footprint by 0.035 km^2 (0.001% of the SCI), resulting in a total long-term footprint of 0.34 km^2 (0.0095% of the SCI) (Table 9.16).

Table 9.16: Structures and materials with the long-term potential to impact on the seabed as part of VDP1

Structures and materials with the long-term potential to impact on the seabed as part of VDP1	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Table reference
Pipeline rock-placement total	*0.0001*	*0.0000*	Table 9.8
AWV rock-placement total	*0.0348*	*0.0010*	Table 9.10
Structures decommissioned in situ total	*0.3060*	*0.0085*	Table 9.12
Total VDP1 seabed impact	***0.3409***	***0.0095***	

The footprint resulting from leaving the pipelines and associated supporting material *in situ* in the LDP1 area is estimated to be 0.24 km^2 (Table 9.17), representing 0.0067% of the area of the SCI. The introduction of rock to the LDP1 area will increase the long-term footprint by 0.017 km^2 (0.0004% of the SCI), resulting in a total long-term footprint of 0.26 km^2 (0.0071% of the SCI) (Table 9.17).

Table 9.17: Structures and materials with the long-term potential to impact on the seabed as part of LDP1

Structures and materials with the long-term potential to impact on the seabed as part of LDP1	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Table reference
Pipeline rock-placement total	*0.0001*	*0.0000*	Table 9.9
AWV rock-placement total	*0.0169*	*0.0004*	Table 9.11
Structures decommissioned in situ total	*0.2394*	*0.0067*	Table 9.13
Total LDP1 seabed impact	***0.2564***	***0.0071***	

VDP1 and LDP1 seabed impact and recovery

The long term presence of the pipelines and existing support materials and the introduction of rock berms for the pipeline ends and for the jack-up AWV, could influence sediment dynamics in the VDP1 and LDP1 areas. Areas of scour have been observed on the lee side of oil and gas structures, and wrecks observed during the 2013 surveys

(Section 4) and similar occurrences may result from the introduction of a hard substrate (rock-placement). These areas of scour are minimal, and recent surveys of the pipelines (Fugro 2014 a, b, c and d) have shown that the majority of pipelines and associated stabilisation materials remain buried (Section 3; ConocoPhillips, 2014g).

To assess the potential for long-term cumulative impacts on sediment dynamics from installed pipelines and associated support structures, ConocoPhillips commissioned an independent review of pipeline route inspection data at points along four pipelines, including where they cross the Swarte Bank sandbank (Senergy Floyds, 2008). Sidescan sonar data was collected from pipelines that had been in place for between 3 and 37 years and was examined for evidence of exposed pipelines, and of any apparent damage or alteration to the form and function of the sandbank. In addition, seabed surface features such as ripple marks continued uninterrupted across the sediment overlying the pipelines (Senergy Floyds, 2008). These results indicate that the presence of the VDP1 and LDP1 pipelines, mattresses and grout bags are unlikely to compromise the integrity of the North Norfolk Sandbanks and Saturn Reef SCI. In addition the presence of structures on sandbanks, monopiles on Scroby Sands Wind Farm, which is located in a highly mobile environment have not been shown to influence the overall form and function of the sandbank (Cefas, 2006).

9.6.3 Fauna disturbance

Structural degradation of the pipeline and mattresses in the VDP1 and LDP1 areas will be a long-term process caused by corrosion and the eventual collapse of the pipelines under their own weight and that of the overlying mattresses, pipeline coating material, scale and sediment. During this process, degradation products derived from the exterior and interior of the pipe 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, overlying rock-placement where applicable and the water column. Any failure is anticipated to begin to occur after many decades and is expected to take up to 500 years to fully degrade (Costain, 2014d). The release of degradation products is expected to occur at a slow rate and therefore expected to have a minimal impact on the surrounding environment.

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

- Pipeline scale;
- Steel;
- Sacrificial anodes;
- Coal tar enamel coating;
- Concrete coating; and
- Plastic coating.

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 of the pipelines will be addressed in Section 11 (Discharges to Sea).

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 metal content of the scale taken from a Viking GD Xmas tree provides an indication of the composition of the pipeline scale present in the VDP1 and LDP1 pipelines (Scotoil Services, 2014). The metals found to be present in the scale include Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Nickel (Ni) and Zinc (Zn).

The chemical components of the carbon steel in the pipelines found in VDP1 and LDP1 are shown in Table 9.18. The bulk constituent of the steel is likely to be iron.

Table 9.18: Pipeline steel chemical components

Element	Composition (maximum %)
Iron (Fe)	Bulk
Manganese (Mn)	1.85
Carbon (C)	0.22
Phosphorus (P)	0.025
Sulphur (S)	0.015
Titanium (Ti)	Combined <0.15
Niobium (Nb)	
Vanadium (V)	

Source: Costain, 2014d.

The pipelines were cathodically protected with zinc bracelet anodes. The cathodic protection system operates on the principle that the anodes will decay in preference to the pipeline material. A typical composition of a zinc anode used in the North Sea is provided in Table 9.19. According to visual survey footage, the majority of the anodes are already fully degraded and the remaining few are partially/ heavily degraded (Fugro 2014a, b, c and d). Most of the chemicals associated with these anodes have therefore already been released into the surrounding environment.

Table 9.19: Zinc anode components

Element	Composition (maximum %)
Zinc (Zn)	Bulk
Aluminium (Al)	0.1 – 0.5
Copper (Cu)	0.05
Cadmium (Cd)	0.025 – 0.07
Lead (Pb)	0.006
Iron (Fe)	0.005
Other	0.1

Source: Costain, 2014c.

The heavy metal input from the anodes is relatively minor when compared to the inputs from the steel. Table 9.19 shows that with the exception of zinc, many of the other components are only present in trace quantities. Hg, Cd, Pb, Cr, Cu, Zn and 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. Prediction of the rates of corrosion is further complicated by the unknown durability of their anticorrosion and concrete coating systems.

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 act as enzyme inhibitors, adversely affect cell membranes, and can damage reproductive and nervous systems. Changes in feeding behavior, digestive efficiency and respiratory metabolism can also occur. Growth inhibition may also occur in crustaceans, molluscs, echinoderms, hydroids, protozoans and algae (Kennish, 1997). It is expected that any toxic levels will be short lived and localised with minimal potential to impact populations of marine species. The potential for uptake and concentration of metals would also be limited to the local fauna and due to the slow release of these chemicals not likely to result in a significant transfer of metals into the food chain.

A benthic species of concern in the area is *S. spinulosa*. Some practitioners consider *S. spinulosa* relatively insensitive to metal or chemical contaminants (Holt *et al*., 1998), although direct evidence is limited. Studies of the response of *S. spinulosa* to an outfall from a bromide extraction works containing free halogens (Hoare and Hiscock, 1974) suggest that it is generally tolerant of changes in water quality (UK Biodiversity Group, 1999). A further study by Walker and Rees (1980) recorded that down-tide of a sewage discharge in Dublin Bay; *S. spinulosa* was present in greater densities and diversities than elsewhere in the bay, indicating a level of tolerance for environmental change.

Given its few key environmental requirements, and its tolerance of poor water quality, *S. spinulosa* is naturally common around the British Isles. A good supply of sand grains put into suspension by strong water movement (either tidal currents or wave action) such as that found in the North Norfolk Sandbanks and Saturn Reef, is thought to be essential for tube building (JNCC, 2008). *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 and steel associated with the concrete coating and mattress protection 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; Costain, 2014d). The area that could be biologically impacted would likely be limited to a few metres on either side of the pipeline.

Naturally Occurring Radioactive Material (NORM)

The presence of NORM contaminated scale was reported in the scale taken from Viking and LOGGS infrastructure. The radiochemical analysis recorded the presence of Radium 226, Actinium 228, Polonium 210, Lead 210 and Thorium 228. The most significant radioactive element in NORM scale and produced water is Radium (Ra) and in particular the stable isotope ^{226} Ra which has a half-life of 1,620 years (OGUK, 2015). Marine organisms can potentially bioaccumulate radium from solution in seawater, from ingested seabed sediments or from their food. Studies of the impacts of ^{226}Ra released into the North Sea via produced water and natural processes indicate that it is unlikely that observed levels of radioactive substances entrained in sediments or found in seawater will cause effects on marine organisms (Hylland and Erikson, 2013; Liland *et al*., 2012).

NORM scale discharged from offshore installations is known to be insoluble in seawater and when produced water rich in barium and radium is discharged to sulphate rich seawater, the radium precipitates rapidly as a complex of barium, radium and sulphate which is also insoluble. ^{226}Ra therefore has a very low concentration in solution in seawater and has a low bio-availability to marine organisms. Dissolved cations in seawater, particularly calcium and magnesium, also inhibit the bioaccumulation of NORM (OGUK, 2015).

Polycyclic Aromatic Hydrocarbons

The base material of the concrete coated pipelines is coal tar. There is no standardised formula for the composition of coal tar, but it is thought that its constituents are over 60% inert and may comprise up to 15% of polycyclic aromatic hydrocarbons (PAHs) (MPE, 1999).

The coal tar coating degrades when the internal pipeline steel corrodes or if the concrete coat is damaged. There are no known records of concrete durability but it is expected that the concrete will decay at a very slow rate. It is presumed that PAH will be released once the coal tar layer is open to the seawater, and over time will be released into the surrounding environment. PAHs in marine sediments will have a low biodegradation potential due to low oxygen and low temperatures. PAHs are almost insoluble and only become available to marine organism through ingestion of particulate matter (MPE, 1999; Cox and Gerrard, 2001).

Two factors, lipid and organic carbon, control to a large extent the partitioning behaviour of PAHs in sediment, water, and tissue. Accumulation of PAHs occurs in all marine organisms; however, there is a wide range in tissue concentrations from variable environmental concentrations, level and time of exposure, and species ability to metabolize these compounds. There are many variables, such as chemical hydrophobicity, uptake efficiency, feeding rate, and ventilatory volume, which may affect the outcome. The route of uptake may be an important issue for short-term events; however, under long-term exposure and equilibrium conditions between water, prey, and sediment, the route of uptake may be immaterial because the same tissue burdens will be achieved regardless of uptake routes (Meador *et al*., 1995). Due to their poor solubility in water these substances will partition in organic material including plankton and marine snow (cell water release) and marine sediments (cell water and sediment

release). All substances in this group are persistent with a half-time in the marine environment ranging from weeks (water column) to several years (sediments).

Evidence of carcinogenicity, mutagenicity or teratogenicity attributable to PAHs in the marine environment is very limited and the amounts concerned are not thought to pose a threat to marine organisms (MPE, 1999). Given that PAHs are expected to be released in very low concentrations during the deterioration of the coating over time, it is unlikely that marine organisms will accumulate them to a significant extent.

Plastics

The plastic layer used to coat the methanol pipelines in the VDP1 and LDP1 areas and the LDP1 gas pipelines is composed of 3 Layer Polyethylene (3PLE) and Fusion bonded Epoxy (FBE) (Costain, 2014d). 3PLE and FBE are 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 (OGUK, 2013). As biodegradability in the marine environment is also low, it can be assumed that the environmental effect of leaving these plastics in place is insignificant (MPE, 1999).

9.7 Cumulative and Transboundary Impacts

Following completion of the VDP1 and LDP1 activities, the total maximum seabed impact is expected to be 0.35 km^2 for VDP1 (Table 9.20) and 0.27 km^2 for LDP1 (Table 9.21). The combined total footprint for both VDP1 and LDP1 is 0.62 km^2, which represents 0.017% of the area of the North Norfolk Sandbanks and Saturn Reef SCI.

Table 9.20: Structures and materials with the potential to impact on the seabed as part of VDP1

Structures and materials with potential to impact on the seabed as part of VDP1	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Table reference
Jacket removal total	*0.0064*	*0.0002*	Table 9.3
Anchoring total	*0.0038*	*0.0001*	Table 9.6
Pipeline rock-placement total	*0.0001*	*0.0000*	Table 9.8
AWV rock-placement total	*0.0348*	*0.0010*	Table 9.10
Structures decommissioned in situ total	*0.3060*	*0.0085*	Table 9.12
Total VDP1 seabed impact	***0.3511***	***0.0097***	

Table 9.21: Structures and materials with the potential to impact on the seabed as part of LDP1

Structures and materials with the long-term potential to impact on the seabed as part of LDP1	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted	Table reference
Jacket removal total	*0.0018*	*0.0001*	Table 9.4
T-piece removal total	*0.0001*	*0.0000*	Table 9.5
Anchoring total	*0.0023*	*0.0001*	Table 9.7
Pipeline rock-placement total	*0.0001*	*0.0000*	Table 9.9
AWV rock-placement total	*0.0169*	*0.0005*	Table 9.11
Structures decommissioned in situ total	*0.2394*	*0.0067*	Table 9.13
Total VDP1 seabed impact	***0.2705***	***0.0075***	

Out with the scope of VDP1 and LDP1 there are also currently 62 platforms, one buoy, 37 subsea structures and 121 subsea pipelines within the SCI, all with varying dimensions and therefore footprints (Appendix F). Based on the lack of information available regarding the physical extent of the footprint, the estimated lifespan and the planned method of decommissioning of these installations, it is difficult to quantify the level of cumulative impact from the existing infrastructure within the SCI.

In addition, stabilisation work has been undertaken by ConocoPhillips at other locations within the SCI. Information regarding tonnage and/ or footprint of rock-placement/ gravel deposits has been provided (where available) in Table 9.22.

Table 9.22: ConocoPhillips stabilisation works in the North Norfolk Sandbanks and Saturn Reef SCI having a potential cumulative impact on the seabed

Block and Facility	Year of installation	Seabed stabilisation laid	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted
49/16: North Valiant 1 PD	2014	11,000 tonnes of rock/ gravel ranging in size from 11 to 22 mm	0.0033	0.00009
49/16: Vanguard QD	2013	8,000 tonnes of rock/ gravel ranging in size from 5 to 20 cm	0.0024	0.00007
49/21: South Valiant TD	2014	30,000 tonnes of rock/ gravel ranging in size from 11 to 22 mm	0.0052	0.00014
49/16: LOGGS PA and North Valiant 1 PD	2014	Seven frond mats laid to counteract scour*	0.0126	0.00035
Total area of impact from ConocoPhillips stabilisation works in the SCI			***0.0235***	***0.00065***

*Note: Dimensions of the frond mats based on the dimensions of a typical North Sea concrete mattress (6 x 3 m)

Source: ConocoPhillips, 2014c.

In addition to ConocoPhillips' activities occurring in the North Norfolk Sandbanks and Saturn Reef SCI, proposed and current deposit consent applications submitted to DECC by other operators indicate further activities are, and will be, undertaken in the SCI. Information provided in Tables 9.22, 9.23 and Appendix F provide details of the level of other oil and gas activity currently within the SCI.

Table 9.23: Recent works by other operators in the North Norfolk Sandbanks and Saturn Reef SCI having a potential cumulative impact on the seabed

Operator	Block	Information source/ DECC Reference
Shell U.K. Limited	48/14	Drilling EIA Direction (Deposit Consent). DRA/172.
	48/8	Pipeline EIA Direction (Deposit Consent). PLA/88.
	49/14b	Marine Licence for Well Intervention. WIA/164
	49/14b	Production EIA Direction (Deposit Consent). PRA/166.
Shell U.K. Exploration and Production Limited	48/19	Production EIA Direction (Deposit Consent). PRA/85.
	49/26	Production EIA Direction (Deposit Consent). PRA/84.
Perenco UK Limited	48/7b	Drilling EIA Direction (Deposit Consent). DRA/142.
	49/28	Pipeline EIA Direction. PLA/145.
	49/23	Pipeline EIA Direction (Deposit Consent). PLA/138.
	49/27a	Production EIA Direction (Deposit Consent). PRA/30.
	49/28	Decommissioning Marine Licence. DCA/7.
Perenco Gas (UK) Limited	49/27	Pipeline EIA Direction (Deposit Consent). PLA/115.
	49/9b	Standalone Marine Licence. SA/263.
E.ON Exploration and Production Limited	48/02	Well Intervention Marine Licence. WIA/73.
Centrica Resources Limited	48/07c	Marine Licence and EIA Direction (Deposit Consent). WIA/30.

Table 9.24 presents the cumulative long-term (rock-placement and structures decommissioned in *situ*) seabed impact on the North Norfolk Sandbanks and Saturn Reef SCI as a result of ConocoPhillips proposed VDP1 and LDP1 activities, combined with stabilisation work undertaken by ConocoPhillips within the SCI. The total maximum cumulative long-term seabed impact as a result of ConocoPhillips activities within the SCI is expected to be 0.6208 km^2, which represents 0.0173% of the area of the North Norfolk Sandbanks and Saturn Reef SCI.

Table 9.24: Cumulative long-term impact from ConocoPhillips VDP1, LDP1 and stabilisation works occurring with the North Norfolk Sandbanks and Saturn Reef SCI

ConocoPhillips activity occurring in the SCI	Year of activities	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted
VDP1 long-term seabed impacts (Table 9.16)	2016 to 2018	0.3409	0.0096
LDP1 long-term seabed impacts (Table 9.17)	2016 to 2018	0.2564	0.0071
Stabilisation works (Table 9.22)	2013/ 2014	0.0235	0.0007
Total area of impact from ConocoPhillips work in the SCI		***0.6208***	***0.0173***

Table 9.24 illustrates that the ConocoPhillips VDP1 and LDP1 activities, in combination with the stabilisation works, will increase the long-term seabed impact within the wider SCI area. However, decommissioning the majority of the subsea VDP1 and LDP1 infrastructure *in situ*, with minimal introduction of additional material into the SCI minimises the cumulative impact of these activities.

As described in Section 4.8.8, three VDP1 platforms and two LDP1 platforms are located within the East Offshore Marine Plan protective area for marine aggregate resource (MMO, 2015). This protective area covers an extensive area of southern North Sea sand and gravel seabed, extending from the east coast of England to approximately 180 km offshore. Removal of the platforms is not expected to impact this resource.

Table 9.25 illustrates that the ConocoPhillips VDP1 and LDP1 rock-placement activities, in combination with the stabilisation works, will add 0.075 km^2 of new material to the seabed. However, this area of new material will cover a very small portion of the extensive protective area, and will have a negligible impact on any future aggregate activities in the area.

Table 9.25: ConocoPhillips VDP1 and LDP1 rock placement activities and stabilisation works occurring within the North Norfolk Sandbanks and Saturn Reef SCI

ConocoPhillips activity occurring in the SCI	Year of activities	Total seabed impact (km^2)	Percentage of SCI seabed (3,603 km^2) impacted
VDP1 pipeline rock placement impacts (Table 9.16)	2016 to 2018	0.0001	0.0000
VDP1 AWV rock placement impacts (Table 9.16)		0.0348	0.0010
LDP1 pipeline rock placement impacts (Table 9.17)	2016 to 2018	0.0001	0.0000
LDP1 AWV rock placement impacts (Table 9.17)		0.0169	0.0005
Stabilisation works (Table 9.22)	2013/ 2014	0.0235	0.0007
Total area of impact from ConocoPhillips work in the SCI		***0.0754***	***0.0022***

The VDP1 and LDP1 activities (from the closest platform) are located 42 km east of the UK/ Netherlands median line. Decommissioning activities are not anticipated to create any transboundary impacts.

9.8 Mitigation Measures

Mitigation measures to minimise seabed impacts within the VDP1 and LDP1 areas are detailed within Table 9.26.

Table 9.26: Planned mitigation measures

Potential sources of impact	Planned mitigation measures
Subsea equipment cutting, excavation and lifting	• Cutting and lifting operations will be controlled by ROV to ensure accurate placement of cutting and lifting equipment and minimise any impact on seabed sediment. • 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
Anchoring activities	• All anchors would be completely removed from the seabed at the end of the decommissioning operations. • Studies have shown that any impact from anchoring will be transient in this area of the North Sea, and any anchor plough marks would revert to background seabed conditions in a short timescale.

Table 9.26 (continued): Planned mitigation measures

Potential sources of impact	Planned mitigation measures
Rock-placement	• A rock-placement vessel or ROVSV (ROV Support Vessel) will be used. The rock mass will be carefully placed over the designated areas of the pipelines and seabed by the use of an ROV controlled fall pipe equipped with cameras, profilers, pipe tracker and other sensors as required. This will control the profile of the rock covering and accurate placement of rock over the pipeline and on the seabed to ensure rock is only placed within the planned footprint with minimal spread over adjacent sediment, minimising seabed disturbance. • Vessel orientation has been reviewed and selected to minimise the requirements for rock whilst allowing for the safe locating of the accommodation work vessel and access i.e. crane reach to undertake essential scopes of work. • The *in situ* decommissioning of the existing pipeline stabilisation material (mattresses, grout bags and rock) will prevent the need for additional rock-placement as support on pipelines to be decommissioned *in situ*. • The profile of the rock-placement over the pipeline and the profile of the AWV rock berms on the seabed will allow fishing nets to trawl over the rock unobstructed. Suitably graded rock will be used to minimise the risk of snagging fishing gear.

9.9 Conclusions

The cutting and lifting of the five jackets associated with VDP1 will create some temporary, short-term disturbance of the seabed sediments, over an estimated area of 0.0064 km^2. This disturbance will be relatively small and occur due to the excavation of the seabed (where required), the manoeuvring of the ROV, and the use of cutting equipment. These activities will be controlled to minimise excavation activity and to ensure accurate placement of cutting and lifting thereby minimising the risk of sediment disturbance.

Anchoring an HLV would result in a footprint of 0.004 km^2 within the SCI. All anchors would be removed from the seabed following decommissioning operations and given the dynamic seabed conditions, recovery of the seabed and associated fauna is expected to be rapid (approximately a year).

Rock-placement activities associated with the *in situ* decommissioning of VDP1 pipelines and the laying of rock berms for AWV stabilisation will impact the sediment through long-term, localised modification of the seabed over an estimated area of 0.035 km^2 and a transient physical disturbance caused by suspension of material into the water column. This impact will be mitigated by controlled rock-placement to minimise seabed footprint. The rock berm profiles will allow fishing nets to trawl over the rock unobstructed.

The rate of colonisation of new rock material for VDP1 is difficult to predict, but as organisms associated with hard substrates will be naturally present in the area, the mattresses and areas of rock-placement provide a relatively small additional habitat for epibenthic rock-dwelling organisms. The decommissioning of the current pipeline stabilisation materials *in situ* will also reduce the amount of additional material needed to be introduced into the SCI and will reduce the amount of seabed disturbance associated with their removal.

The footprint resulting from leaving the pipelines and associated supporting material *in situ* in the VDP1 area is estimated to be 0.34 km^2. Long-term degradation of the pipelines and mattresses will introduce chemical contaminants to the sediment and water column over an extended period. These chemicals are not expected to rise above

background levels in the water column or result in long-term toxicity to marine organisms. It is anticipated that failure of the pipelines due to through-wall degradation would only begin to occur after many decades.

Overall, the VDP1 facilities are expected to create a maximum seabed impact of 0.35 km^2, representing 0.0097% of the total area of the North Norfolk Sandbanks and Saturn Reef SCI (Table 9.20).

The cutting and lifting of the three jackets and the T-piece under LDP1 may create some short-term disturbance of the seabed sediments, over an estimated area of 0.002 km^2. This disturbance will be relatively small and occur from the manoeuvring of the ROV and cutting equipment. These activities will be controlled to minimise excavation activity and to ensure accurate placement of cutting and lifting thereby minimising the risk of sediment disturbance.

Anchoring an HLV would result in a footprint of 0.0023 km^2 within the SCI. All anchors would be removed from the seabed following decommissioning operations and given the dynamic seabed conditions, recovery of the seabed and associated fauna is expected to be rapid (approximately a year).

Rock-placement activities associated with the *in situ* decommissioning of LDP1 pipelines and the laying of rock berms for AWV stabilisation will impact the sediment through long-term, localised modification of the seabed over an estimated area of 0.025 km^2 and a transient physical disturbance caused by suspension of material into the water column. This impact will be mitigated by controlled rock-placement to minimise seabed footprint. The rock berm profiles will allow fishing nets to trawl over the rock unobstructed.

As for VDP1, the rate of colonisation of new rock material is difficult to predict, but as organisms associated with hard substrates will be naturally present in the area, the mattresses and areas of rock-placement provide a relatively small additional habitat for epibenthic rock-dwelling organisms. The decommissioning of the current pipeline stabilisation materials *in situ* will also reduce the amount of additional material needed to be introduced into the SCI and will reduce the amount of seabed disturbance associated with their removal.

The footprint resulting from leaving the pipelines and associated supporting material *in situ* in the LDP1 area is estimated to be 0.024 km^2. Long-term degradation of the pipelines and mattresses will introduce chemical contaminants to the sediment and water column over an extended period. These chemicals are not expected to rise above background levels or result in long-term toxicity to marine organisms. It is anticipated that failure of the pipelines due to through-wall degradation would only begin to occur after many decades.

Overall, the LDP1 facilities are expected to create a maximum seabed impact of 0.27 km^2, representing 0.0075% of the total area of the North Norfolk Sandbanks and Saturn Reef SCI (Table 9.21).

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10.0 SOCIETAL IMPACTS

This section discusses the potential short to long term societal impacts associated with the proposed decommissioning activities of the VDP1 and LDP1 facilities. The measures taken or planned by ConocoPhillips to minimise these impacts are detailed in Section 10.6.

10.1 Regulatory Context

Societal impacts generated from the proposed activities associated with the decommissioning of the VDP1 and LDP1 infrastructure will be managed in accordance with current legislation, guidelines and standards, as detailed in Appendix A.

10.2 Approach

During the risk assessment process (Section 6) and comparative assessment the following issues were noted as having a societal impact:

- An increase in vessel collision risk between the decommissioning vessels with other users of the sea.
- Damage or loss of fishing gear may occur from potential snagging hazards on the seabed.

The impacts described in the following sections are similar for both the VDP1 and LDP1 decommissioning areas, and therefore, one assessment was conducted with any additional site specific details highlighted.

10.3 Sources of Potential Impacts

The following provides a description of the two issues associated with the proposed decommissioning operations that were identified as having a societal impact.

10.3.1 Decommissioning vessel presence

There may be the potential for short term impacts as a result of disruption to previously established shipping operations in the area, while vessels carry out surveys, removal and rock-placement activities. For the duration of the proposed activities, the physical presence of the decommissioning vessels will increase the current vessel activity in the vicinity of the VDP1 and LDP1 infrastructure.

A maximum of eight vessels may be present at any one time within the VDP1 and LDP1 decommissioning areas to undertake structure removal and rock-placement operations. The type of vessels present could include:

- DSV;
- CSVs;
- HLV;
- AWV;
- Rock-placement/ trenching vessel;
- Pipe reel/ lay vessels; and
- Survey vessels.

10.3.2 Potential snagging hazards

The physical presence of the pipelines, rock-placement, seabed depressions/ anchor scars and mattresses/ grout bags increases the potential for interaction with fishing gear. 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.

Conversely, as the decommissioning activities proceed there will be a positive impact. New areas of sea will become available to fisheries through the removal of the 500 m safety exclusion zones that currently surround the eight VDP1 and LDP1 platforms.

As detailed in Section 3, the pipelines, mattresses and grout bags are to be decommissioned *in situ,* with the pipeline ends protected with rock-placement or re-trenched. For the purposes of this assessment, a worst-case has been used involving the use of rock-placement on pipeline ends, rather than re-trenching. There is the potential for a number of depressions and berms to be left on the seabed following decommissioning. These would arise from:

- Anchoring the HLV;
- Deploying the AWV spud cans (where rock-placement is not necessary); and
- Excavation at the platform footings to enable these to be severed from the seabed, if internal cutting is not possible.

ConocoPhillips are undertaking SSAs to determine whether rock placement will be required on the seabed at the AWV locations, to protect against possible punch-through and seabed scour at the AWV spud can locations. Initial SSAs have indicated rock-placement (rock berms) will be required at seven of the eight VDP1 and LDP1 platform locations. Rock berms associated with the AWV will be left *in situ* following the completion of the decommissioning activities.

The final SSAs will be provided as supporting documentation in the direction for deposits applications which will be submitted to the DECC to seek approval for the commencement of the rock-placement operations at each platform location. The volume of rock and site specific berm design will be detailed within each application, and will be based on the final SSA results.

10.4 Impacts on Sensitive Receptors

Receptors potentially impacted by the proposed decommissioning activities may include:

- Commercial shipping (cargo, oil and gas related); and
- Commercial fishing.

10.4.1 Commercial shipping

Commercial shipping traffic density within the UKCS blocks associated with the VDP1 and LDP1 infrastructure (Blocks 48/25, 49/16, 49/17 and 49/21) ranges from very low to high (Section 4.8.4). Approximately 1,600 vessels per year are thought to pass in the vicinity of the VDP1 and LDP1 decommissioning areas.

The shipping channels in the vicinity of VDP1 and LDP1 are well established and vessel traffic associated with oil and gas infrastructure in the area is well understood. The use of historic shipping data for the decommissioning area (Section 4.8.4) provides an appropriate indication of the expected vessel activity.

VDP1 area

The VDP1 infrastructure is situated in Blocks 49/16 and 49/17 with moderate and very low vessel densities, respectively (Section 4.8.4). Moderate vessel density in Block 49/16 is concentrated in the south west of the block, approximately 10 km from the nearest VDP1 infrastructure (MMO, 2014; ACCSEAS, 2014). No significant impacts to shipping are anticipated with decommissioning of the VDP1 infrastructure.

LDP1 area

The LDP2 infrastructure is situated in Blocks 49/16, 49/21 and 48/25 with moderate and high vessel densities. A vessel route transects Blocks 49/16 and 49/21 (Section 4.8.4). The closest LDP1 infrastructure to this route is the infield pipelines (PL1692 and PL1693) in Block 49/16 which link the Vampire OD platform to the LOGGS PR installation. The vessel route is located approximately 300 m from the LOGGS PR installation 500 m safety exclusion zone. All of the platforms have 500 m safety exclusion zones in operation. The jacket and topside removal and rock-placement operations will be conducted within these 500 m safety zones, excluding unauthorised vessel traffic in the vicinity of the decommissioning activities. The pipeline ends at LOGGS PR (PL1962 and PL1693) will not be severed under LDP1 as the LOGGS PR platform is still a live platform.

The East Inshore and Offshore Marine Plans highlight two dredging transit routes which run between the Vampire and Viscount platforms in Block 49/16 (MMO, 2015). These dredging transit routes are located well away from the platforms' 500m safety exclusion zones where the majority of the decommissioning activities will occur. Any survey work conducted along the Vampire OD to Viscount VO pipeline route will be short in duration and will be similar to other navigational considerations that transit vessels would encounter with other sea users. No significant impacts are anticipated with decommissioning of the LDP1 infrastructure.

10.4.2 Commercial fishing

With respect to commercial fishing, there is the potential for snagging hazards from seabed obstructions (pipelines, rock-placement, seabed depressions/ anchor scars and mattresses/ grout bags) and increased collision potential based on increased vessel numbers operating in the vicinity of the VDP1 and LDP1 infrastructure during decommissioning (Section 10.4.1).

Vessel collision risk

As discussed in Section 10.4.1, the majority of decommissioning vessel activity will be conducted within the platforms' 500 m safety exclusion zones; these exclusions will remain for the duration of the decommissioning activities. Vessel activity that may occur outside of the exclusion zones will be associated with:

- Site specific surveys conducted before decommissioning operations commence;
- Post-decommissioning survey work; and
- Debris cleaning/ overtrawl activities.

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

Snagging hazards

Of most concern to commercial fishing is the potential risk for snagging posed by pipelines, rock-placement, seabed depressions/ anchor scars and mattresses/ grout bags decommissioned *in situ*.

Pipelines decommissioned *in situ* pipelines and rock-placement

The predominant fishing method in the decommissioning area is beam trawl (Section 4.8.1). 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. These vessels tow this heavy gear at speeds of up to seven knots. The combination of large horsepower vessels, relatively fast towing speeds and heavy gear creates a considerable potential for gear and infrastructure interactions (Brown and May, 2014). These interactions could result in damage to both the fishing gear and the decommissioned pipelines. However, due to the vessel parameters mentioned earlier and the relatively small diameter (2 to 12") pipelines present, the potential for any strike between fishing gear and pipeline resulting in a vessel coming fast and in turn sinking, is low.

In addition, the Dutch fleet have begun to change fishing gear types towards a pulse/ SumWing® beam which is a considerably lighter beam gear, similar in shape to a hydrofoil. Some versions of this equipment have been modified to include an electronic trailing tickler system. This lighter gear has a higher risk of snagging due to its construction and as such fisheries utilising this gear have currently been avoiding areas where there are known pipelines or potential snagging risks (Brown and May, 2014). It is anticipated that these fisheries will maintain their avoidance of this area post-decommissioning, resulting in no additional loss to current fishing grounds or practices.

Furthermore, VMS data indicates the majority of fishing effort by the Dutch fleet is targeted out with the decommissioning area (Section 4.8.1, Figure 4.23). These data are representative of vessels over 15 m in length and as such, account for the majority of the vessels working in this offshore area.

ConocoPhillips intends to decommission the infield pipelines included in VDP1 and LDP1 *in situ* with minimum intervention along the pipeline length. The pipelines have been on the seabed for between 12 and 40 years and are marked on fishing charts. The fisheries have been aware of their presence and have been continuing to use the surrounding seabed area without severe incident.

Previous surveys have indicated that although the seabed is dynamic in nature and some spanning is evident, the spans have not exceeded 1.0 m in height. During the operating life of the VDP1 and LDP1 pipelines, there have never been any reportable spans (spans exceeding 0.8 m in height) documented on any of the pipelines to be decommissioned (Tables 3.8 and 3.12). Pipelines where similar sections have been surveyed regularly have shown that observed spans are filled and re-exposed over time (Costain, 2014a).

Although rock-placement on the cut pipeline ends is proposed as a worst-case for the purpose of this assessment, the risk posed is minimal. The area covered by the rock-placement at each pipe end is approximately 1.8×10^{-5} km^2, requiring a rock volume of approximately 25 tonnes per pipeline end. This rock-placement will be graded and selected for a size that is most suitable for the fishing gear used in the area to allow overtrawlability with minimal adverse impact.

Mattresses/ grout bags and AWV associated rock-placement

Each pipeline has associated mattresses and grout bags that ConocoPhillips intends to decommission *in situ* without further intervention. Details of these are summarised in the following sub-sections. Mattresses may present snagging hazards to fishing gear depending on the burial status, design and state of degradation.

Mattresses have proven a successful means of pipeline stabilisation across both decommissioning areas. Many of these mattresses are currently buried/ partially buried and based on the dynamic nature of the seabed there exists the potential for them to become exposed. These mattresses have been put in place to maintain the stability of the buried pipeline. If they were to be removed, additional rock-placement would need to be installed to maintain the stability of the pipelines, preventing the potential for more serious spanning of the decommissioned *in situ* pipelines in the future.

Deposition of rock-placement to aid stabilisation of the AWV will be required at seven of the eight VDP1 and LDP1 platform locations (Section 3.8; Table 3.24). In addition contingency rock will be applied for to remediate against the effects of scour whilst the vessel is on location at the one platform (Vulcan UR) where rock placement is not required for the locating of the AWV. The exact volume of rock required at each location is are currently being calculated, based on the ongoing SSAs.

Depending on the height of the stabilisation material above the seabed surface and the angle of the rock berm slope, the rock-placement profile may present an obstacle to fishing gear which may get tangled, snagged or damaged during normal fishing operations. There is also the potential for scour pits to develop around these rock berms. Depending on the height of the rock-placement and the speed of the prevailing currents, these pits could become large and pose a potential risk to trawl doors or beams which could get stuck in the edge of the pit or on the edge of an eroded rock-placement.

ConocoPhillips anticipate, as a worse case, each rock berm will be designed to be 4.0 m in thickness, with a slope gradient of 1 in 5 applied to the berm.

The final SSAs will be provided as supporting documentation in the direction for deposits applications which will be submitted to DECC for approval for the commencement of the rock-placement operations at each platform location. The volume of rock and site specific berm design will be detailed within each application, and will be based on the final SSA results.

Following removal of the AWV a proportion of rock berm will be pressed into the seabed with the weight of the AWV. ConocoPhillips estimate each spud can will penetrate approximately 1.5 m of a 4.0 m high rock berm, with the main bearing area fully embedded (Figure 3.10; GlobalMaritime, 2015). However, areas of rock berm will remain on the seabed surface. Removal of the rock-placement following the completion of the cleaning activities at each platform site will not be practical; however notification will be issued to fishermen and other users of the sea as to the location of these areas of rock-placement.

Recent visual survey observations of the Viking field pipelines indicate that rock-placement may collapse over time and in many of the pipeline cases these rock berms have been buried or partially buried with sediment (ConocoPhillips, 2014g). Based on these observations, ConocoPhillips would anticipate that the rock berms left in situ following the AWV activities naturally settle and collapse over time with the mobile seabed sediments in the area expected to bury the remaining profile.

Potential mitigation measures may be considered following discussions with DECC and Stakeholders. Mitigation could include redistributing the piles of rock-placement so that they present a shallower profile; this would increase the overall footprint of the rock-placement but overtime it is anticipated that this could become covered by the mobile sediments in the area as is evident with the mattresses and rock-placement currently *in situ*. The risk to fisheries is assessed to be medium but the likelihood of impact is low, and so the overall impact is expected to be minor.

Seabed depressions/ anchor scars

The decommissioning activities will result in a number of seabed depressions and anchor scars. If rock-placement is not necessary for stabilisation, depressions may result from the removal of the jacket and from the associated jack-up legs of the AWV.

The use of a HLV at each of the eight platforms has the potential to create anchor scars on the seabed (Section 9). Seabed impacts based on a 10 tonne 'flipper delta' anchor with a total chain length of 1,250 m and a maximum contact length of 975 m were assessed in Section 9.

ConocoPhillips intends, where free from obstructions, to remove the jacket from the seabed by means of internal cuts to sever the pile connections in the seabed. It is anticipated that this will be possible on all five VDP1 platforms and the Vampire OD and Viscount VO platforms under LDP1, however, the Vulcan UR platform will need to be excavated from the seabed to allow access for an external cutting tool.

The cleaning and engineering down of the platform topsides will be undertaken using an AWV jack-up vessel. There is the potential that some of the platform sites will have a sediment structure which will allow the deployment of the legs without the requirement for a rock pad. In these situations there will be a depression left on the seabed once the AWV moves off site. For the purposes of this ES, ConocoPhillips have based the assessment on an AWV with four jack-up legs, each with a spud can footprint of 3×10^{-5} km^2. The vessel specifications used in the assessment estimate a maximum protrusion into the seabed of 3.5 m.

Based on the dynamic nature of the environment in the vicinity of these platforms it is anticipated that these depressions will backfill naturally over time. Section 9.5.1 refers to the natural recovery of anchor scars and similar depressions between 1 and 5 years, depending on the environmental conditions present (Loe, 2010; DECC, 2011; Hill *et al*., 2011; Thompson *et al*., 2011). Overtrawl trials would be undertaken to ensure there are no berms or snagging issues associated with these depressions, identifying the location of the jack-up legs and anchor deployments within the area.

VDP1 area

The VDP1 area includes five satellite platforms and ten infield pipelines. The infield pipelines all terminate at the Viking BD installation, however, the Viking BD installation is not included in the VDP1 infrastructure. The pipeline ends situated at the Viking BD platform will not be cut and subject to any rock-placement under VDP1 and the platform's 500 m safety exclusion zone will remain in place following the decommissioning of the infield pipelines. It should be noted that the Viking BD installation will be decommissioned at some point in the future.

After decommissioning the VDP1 infrastructure, the 500 m exclusions zones around the five satellite platforms will be removed allowing access to the areas protected by rock-placement. As these will be identified on navigation charts, have a relatively small

footprint (9 x 10^{-5} km^2 in total) and are composed of graded rock, the potential risk to snagging fishing gear is considered low to negligible.

VDP1 infield pipelines comprise five infield gas lines, each piggybacked with a methanol flow line. The burial and exposure status of these pipelines are summarised in Table 3.8. The majority of the pipelines have a low percentage of exposure, with the exception of the infield lines between Viking ED and Viking BD which, had 32.5% of the pipeline exposed during a 2011 survey. As previously stated, the project specific burial study indicates that the location and size of the spans changes over time (Costain, 2014a). The results presented in Table 3.8 show the most recent survey with the longest pipeline length surveyed. Even with the changes in position and size, over time the percentage of exposure is relatively stable (Costain, 2014a).

These pipelines will be surveyed post-decommissioning to establish their exact position and this information will be included into navigational charts. Post-decommissioning monitoring of the pipeline will be agreed with DECC following the post-decommissioning survey to confirm burial status. The frequency and duration of the monitoring programme will be agreed with DECC and will be dependent on the observed stability of the pipelines. In summary, the risk to commercial fishing from the VDP1 infield pipelines is assessed to be minor because:

- Vessels will know the exact location of the decommissioned pipelines;
- There is a low level of fishing effort targeted in the area; and
- A post-decommissioning monitoring programme will be agreed with DECC.

The estimated number of mattresses associated with the VDP1 infrastructure is summarised in Table 10.1. Mattress dimensions are assumed to be 6 x 3 m. A post-decommissioning survey will be conducted to accurately ascertain the current position of the mattresses and a post-decommissioning monitoring programme will be agreed with DECC. The exposed/ partially exposed mattresses, identified through surveys of the pipelines cover a total area of 5.4 x 10^{-4} km^2 (Table 10.1), however due to the dynamic nature of the seabed (Section 4.1.1) there is potential that the burial status of these mattresses may change over time. It should also be noted however that a number of these mattresses were designed with integrated frond mats. These were designed to help reduce the seabed current and retain sediments to help maintain burial. From the video footage ConocoPhillips have collected, it is evident that this has been successful in maintaining full or a large degree of burial of these mattress types. Based on the mitigation proposed (Section 10.6) and the level of current fishing activity in the area, the risk to fishers snagging gear on exposed mattresses is assessed to be minor.

Table 10.1: Estimated mattresses protecting VDP1 pipelines

Infrastructure from	Infrastructure to	Pipelines being protected by mattresses	Estimated number of mattresses	Total footprint area
Viking CD	Viking BD	PL0089 & PL0132	6	1.08 x10^{-4} km^2
Viking DD	Viking BD	PL0090 & PL0131	10	1.80 x10^{-4} km^2
Viking ED	Viking BD	PL0091 & PL0133	11	1.98 x10^{-4} km^2
Viking GD	Viking BD	PL0092 & PL0066	0	0 km^2
Viking HD	Viking BD	PL0093 & PL0130	3	5.4 x10^{-5} km^2
Total				**5.4 x10^{-4} km^2**

Source: Costain, 2014b.

LDP1 area

The LDP1 area incorporates three satellite platforms, six infield pipelines and a T-piece junction. Following the removal of the 500 m safety exclusion zones around the three satellite platforms, there will be four areas over pipeline ends to which fishing vessels would have access. These areas of rock-placement will be marked on navigational charts; their seabed footprint is relatively small (approximately 1.08 x 10^{-4} km^2 in total) and the rock will be graded. The potential risk of snagging fishing gear is assessed to be low to negligible.

The LDP1 infield pipelines comprise of three infield gas lines each piggybacked with a methanol flow line. The burial status of these pipelines is summarised in Table 3.12. All LDP1 pipelines have less than 1% of their lengths exposed, indicating they are relatively well buried and stable. The surveys conducted between 2008 and 2012 found the exposed areas were in close proximity to the platform ends of the pipelines.

The most recent survey (2011) of the Vulcan UR pipelines found that the exposed area was concentrated at the Vulcan RD installation. This installation is not being removed under the current decommissioning phase and therefore the installation's 500 m safety exclusion zone will remain in place. This will minimise any potential impact from the exposed pipeline end. The results presented in Table 3.12 are the most recent survey with the longest length of pipeline surveyed. These pipelines will be surveyed post-decommissioning to establish their exact position and the information will be included in navigational charts. A monitoring programme to confirm burial status will be agreed with DECC. The potential risk to commercial fishing is assessed to be negligible.

The estimated number of mattresses associated with LDP1 infrastructure is summarised in Table 10.2. Mattress dimensions are assumed to be 6 x 3 m. A post-decommissioning survey will be conducted to provide an accurate position of the mattresses and other structures decommissioned *in situ*, these may be further monitored as part of any post-decommissioning monitoring programme agreed with DECC. A seabed area of 0.00175 km^2 is estimated to be covered by mattresses based on observations of exposed/ partially exposed mattresses along the pipeline lengths, however due to the dynamic nature of the seabed in the area there is potential for the burial status of these mattresses to change over time. Based on the mitigation proposed (Section 10.6) and the level of current fishing activity in the area, the potential risk of snagging fishing gear is assessed to be minor.

Table 10.2: Estimated mattresses protecting LDP1 pipelines

Infrastructure from	Infrastructure to	Pipelines being protected by mattresses	Estimated number of mattresses	Total footprint area
Vulcan UR	Viking RD	PL0462 & PL0463	2	3.6 x10^{-5} km^2
Viscount VO	Vampire OD	PL1962 & PL1936	42	7.56 x10^{-4} km^2
Vampire OD	LOGGS PR	PL1692 & PL1693	53	9.54 x10^{-4} km^2
Total				**1.75 x10^{-3} km^2**

Source: Costain, 2014b.

The Vulcan UR jacket cannot be cut at its base using internal cutting methods; therefore the legs will need to be excavated to gain access with the cutting tool. As a result, a worst case estimate has been based on cutting all the jacket structures 3.0 m below the seabed. This will require an excavation to 4.0 m with a sloped edge to ensure the pit walls are stable. The slope will depend on soil type and current/ tide conditions. Based on experience from the ConocoPhillips Subsea Team, an approximately 30 degree slope

will be needed, resulting in a circular excavation of 14.0 m diameter and depth of 4.0 m in the centre and tapered up to the seabed. As the seabed is very dynamic, sandwaves are anticipated to naturally infill the depression within 1 to 5 years (DECC, 2011; Loe, 2010).

10.5 Cumulative and Transboundary Impacts

There are a number of existing oil and gas installations within close proximity to the VDP1 and LDP1 infrastructure. Cumulative impacts to fisheries may occur if the extent of an area impacted is significant with respect to the total area available for fishing.

There will be a cumulative impact associated with the rock-placement (Section 9), however, the area covered by the additional rock will be far less than the area of seabed released for use by fisheries through the removal of the 500 m safety exclusion zones at each of the eight platforms.

The combined areal extent of the small areas of mattresses/ grout bags and of exposed pipeline is relatively insignificant in comparison to the available fishing grounds in the area, and therefore cumulative impacts are not anticipated.

As the decommissioning activities proceed, new areas of sea will become available to fisheries, reducing the overall cumulative impact to fisheries and resulting in a positive impact.

The pipelines, mattresses and associated rock-placement are all localised and within UK waters, so there will be no transboundary impacts.

10.6 Mitigation Measures for VDP1 and LDP1 Areas

Mitigation measures to minimise societal impacts are detailed in Table 10.3. All of the decommissioning activities other than survey work will be conducted within the current 500 m safety exclusion zones and so the use of guard vessels is deemed not necessary.

Table 10.3: Planned mitigation measures

Potential sources of impact	Planned mitigation measures
Physical presence of decommissioning vessels causing potential interference to other users of the sea.	• Prior to commencement of operations, the appropriate notifications will be made and maritime notices posted. • All vessel activities will be in accordance with national and international regulations. • Appropriate navigation aids will be used in accordance with the consent to locate conditions to ensure other users of the sea are made aware of the presence of vessels.
Damage to or loss of gear as a result of subsea obstructions, decommissioned *in situ,* posing potential snagging risks.	• The use of a fall pipe on the rock-placement vessel and the use of ROV supervision during rock-placement operations will ensure correct rock-placement. • On-going consultation with fisheries representatives. • The placement of rock will be designed to be overtrawlable. • Post-decommissioning seabed clearance and an overtrawlability survey will be conducted.
Long-term environmental impacts of the physical presence of the pipelines, mattresses and rock-placement on the seabed.	• Post decommissioning survey to accurately map the location of subsea structures decommissioned *in situ*. • Potential post-decommissioning monitoring (for up to10 years) of routes of the buried pipeline routes will be discussed as part of any future monitoring programme agreed with DECC. • Potential remedial intervention in the event issues arise with the pipeline interacting with other users.

10.7 Conclusions

The transient loss of access for vessels during the decommissioning operation is unlikely to have a significant impact on other sea users (i.e., commercial shipping and fishing). This is because the majority of the proposed decommissioning activities will occur within the 500 m safety exclusion zones around each of the VDP1 and LDP1 installations.

The pipelines decommissioned *in situ* will be surveyed post-decommissioning to accurately record their location and status. This information will be included in navigational charts and passed on to representatives of the fishing community (e.g., NFFO, SFF, ANIFPO and NIFPO). The VDP1 and LDP1 pipelines have been present on the seabed for a number of years (1971 to present) with fisheries aware of their presence. To date, there have been no recorded issues/ interactions between these pipelines and other users of the sea. As locations of the pipelines are known and occupy a relatively small area of seabed, the potential risk of impact on fisheries from the decommissioning operations is assessed as minor.

There is the potential that fisheries access to small areas of seabed may be compromised due to the presence of rock-placement or mattresses decommissioned *in situ*. Previous overtrawl tests have indicated that the risk from rock-placement is minimal but that areas covered by mattresses may pose some minor risk of loss or damage to fishing gear. ConocoPhillips therefore propose to mitigate against this through a series of measures including a post-decommissioning survey to accurately record the seabed position of the mattresses/ grout bags and include the locations on navigational charts, and to conduct any future monitoring programmes agreed with DECC. Representatives of the fishing community will be consulted at all relevant stages of project as it develops. Overall, the impact for the fishing community is assessed to be minor.

There are no negative cumulative or transboundary societal impacts. The decommissioning of the eight platforms may result in a positive impact by opening up new fishing grounds previously unavailable due to the 500 m safety exclusion zones currently imposed around the installations.

11.0 DISCHARGES TO SEA

This chapter provides a brief summary of potential planned discharges to sea resulting from VDP1 and LDP1 decommissioning operations. Potential impacts to seabed sediments, including the associated benthic fauna are reviewed in Section 9. Any unplanned discharges during accidental events are not included, but presented in Section 12.

11.1 Regulatory Context

Discharges to sea generated from the decommissioning of the VDP1 and LDP1 facilities will be managed in accordance with current legislation and standards as detailed within Appendix A.

11.2 Approach

During the decommissioning of the VDP1 and LDP1 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 cutting and removal operations; and
- Long-term release of residual contaminants in subsea pipelines, through pipeline degradation over time.

This chapter assesses: the type of potential contaminant, the magnitude of impacts arising from potential contamination to sensitive receptors, and outlines the mitigation measures that ConocoPhillips will put in place.

ConocoPhillips will ensure that every effort is made to achieve an acceptable level of cleanliness; in turn, reflecting the intent of current Health and Safety Executive (HSE)/ DECC guidance. The decommissioning guidelines (DECC, 2011a) encourage operators to utilise the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 Guidance Notes, in the first instance when assessing the potential for discharges to sea during operations (DECC, 2014d).

During production, OSPAR Recommendation 2001/1 requires all installations to achieve a 30 ppm performance standard for entrained oil in water intentionally discharged or unavoidably released to sea; compliance is achieved through Oil Discharge Permits as described in the OPPC guidance. The concentration of dispersed oil in water as averaged over a monthly period must not exceed 30 ppm, whereas the maximum permitted concentration must not exceed 100 ppm at any time.

Such releases are most likely to occur during pipeline cutting. It will be difficult to accurately monitor concentrations that escape during this process, so in consultation with DECC, a predicted level of cleanliness will be targeted during operations. The current intention is to flush all pipelines until a cleanliness of <30 ppm is attained in the arrival fluid.

11.3 Sources of Potential Impacts

The following section provides an overview of the two main subsurface discharge streams (excluding accidental), that may have an environmental impact; namely the remaining gas pipelines and piggybacked methanol lines. ConocoPhillips do not foresee the opportunity for any contaminants to be discharged during the removal of topside

decommissioning operations. All pipelines and tanks will be drained and then nitrogen purged prior to disassembly. Any solid contaminants remaining will be skipped and shipped.

The section will also consider both the immediate or short-term subsurface discharges from decommissioning activities and the potential for long-term release through *in situ* pipeline degradation.

11.3.1 Potential contaminants in subsea pipelines

The gas pipelines contain a residual mixture of produced water, gas condensate, iron oxides, produced sand and other minerals/ trace elements. An accurate estimation of fluids or solids remaining in pipelines and pipework is difficult. It is estimated that fluid volumes for the pipeline contents for the VDP1 gas lines range between 267 and 822 m^3. The volumes for the pipeline contents for the LDP1 gas lines are estimated to range between 243 and 797 m^3 (Costain, 2014c).

During and post-flushing, the arrival water will be tested at the Viking BD/ LOGGS platform via an access bleed point in the cap/ plug, to evidence a prescribed cleanliness level. For the gas pipelines, the most suitable method for cleaning the pipelines to a suitable level is to use a gel/ foam pig. Pipeline hydrocarbon liquids and solids are separated offshore and filtered solids collected for shipment to shore for onshore disposal. Hydrocarbon liquids will be primarily disposed of via the disposal wells (VDP1-well BD03; LDP1 - well to be determined), dependent on the individual constituent volumes and flow rates encountered (Costain, 2014c).

The use of a foam/ gel pig train would provide positive displacement of the pipeline contents with seawater. A gel pig can be utilised to remove the condensate and any mobile solids with minimal removal of adhered solids, holding debris in suspension and potentially reducing the volumes of resulting water and waste materials (Costain, 2014c). Some solids will remain in the lines post flushing.

11.3.2 Potential contaminants in piggybacked methanol lines

The estimated volumes for the pipeline contents for the VDP1 methanol lines are between 7 and 11 m^3. The volumes for the pipeline contents for the LDP1 methanol lines are between 10 and 39 m^3 (Costain, 2014c). Residual fluids within the piggybacked lines will include methanol and corrosion inhibitors. No solids are expected to occur in these lines (Costain, 2014c).

11.4 Predicted Residual Contaminants

The following contaminants are identified as likely to enter the marine environment as a result of strategies currently presented for the decommissioning process. The majority will result from the short term instantaneous release of material or fluid following a removal action, or the long-term slow release of a contaminant through the degradation of infrastructure decommissioned *in situ*.

11.4.1 Chemicals

The most suitable method for cleaning the methanol lines is to flush and dispose of the contents via re-injection into well BD03 (or LDP1 equivalent). It is anticipated that following flushing, there should be no chemicals left within the methanol lines. However should there be any residual traces of chemicals left in the lines, these should not pose any significant risk to the marine environment as all of these chemicals are on the

PLONOR List, and all the relevant eco-toxicological information has already been submitted to the regulator.

11.4.2 NORM scale

The presence of NORM contaminated scale has been confirmed in the Viking and LOGGS Field pipework based on evidence from cleaning and sampling reports for the TGT pig catcher and the scale analysis for the Viking and LOGGS infrastructure. All recovered pipework will be monitored for NORM scale; with any deposits collected being tagged, handled and quarantined accordingly.

ConocoPhillips has an existing procedure in place for managing radioactive waste and the local rules for working with radioactive materials will be revised to include the removal and transportation of radioactive materials during decommissioning in consultation with the Environment Agency. Radiochemical analysis of Viking and LOGGS infrastructure has recorded Radium 226, Actinium 228, Polonium 210, Lead 210 and Thorium 228 (Scotoil, 2003). Solid wastes are discussed in detail in Section 9.

11.4.3 Heavy metals

Traces of the following heavy metals have been recorded in scale deposits within the Viking and LOGGS structures: arsenic, cadmium, chromium, copper, mercury, nickel and zinc (Scotoil, 2003). It has been assumed that similar heavy metals will be present in the pipework which has been exposed to production fluids, however quantities are not known. Further information on the toxicity and impacts of these trace elements is provided in Section 9.

11.4.4 Entrained hydrocarbons

During decommissioning activities such as pipeline cutting there is the opportunity for entrained fluids to enter the marine environment in small quantities. Contaminants include residual hydrocarbons, along with dissolved organic and inorganic compounds that were present in the geological formation. The impact of discharging this fluid to the environment is dependent on a number of physical, chemical and biological processes including: volume and density of discharge, dilution, volatilisation or low molecular weight hydrocarbons and biodegradation of organic compounds. Hydrocarbons do not affect all components of marine ecosystems equally (OSPAR, 2009). A summary of key eco-toxicological effects is presented in Table 11.1.

Table 11.1: Summary of key eco-toxicological impacts resulting from hydrocarbon discharged to the environment

Receptor	Eco-toxicological impact
Planktonic organisms	Can experience toxic effects from oil in water; the high turnover of populations renders plankton relatively unaffected.
Invertebrates	Sensitivity varies greatly; corals among the most sensitive. Shellfish may accumulate oil residues with attendant secondary effects, particularly relating to health.
Fish	Eggs and larvae more susceptible to toxic effects than adults; hydrocarbons may accumulate in adult tissues - may affect health/taint flesh.
Birds	Large quantities may coat feathers reducing buoyancy and insulation, leading to increased mortality. Exposure to potential toxic effects from ingesting oil with food or from preening. May also affect breeding success.
Marine mammals	Leads to skin/ eye irritation. Exposure to potential toxic effects from ingesting oil with food.

The toxicity of oil contaminated water has also been investigated in laboratory tests using a number of taxa, including algae, invertebrates and fish. Such studies have found that entrained water is non-toxic after a 20-fold dilution factor (Somerville *et al*., 1987). Any significant effects would be limited to a small area around the discharge or release point. During operations, the fluids released should have only residual amounts of entrained hydrocarbons, based on reaching a level of 30ppm within the arrival fluid during cleaning. This should rapidly disperse/evaporate, presenting minimal likelihood of long-term persistence. Due to the low volumes and concentrations being discharged, the potential for bioaccumulation is remote.

Hydrocarbon components and their effect on the environment

Potential toxic components from residual fluids include PAHs and alkylphenols. These compounds are more likely to have a detrimental impact on organisms living within the water column.

- PAHs - Evidence of carcinogenicity, mutagenicity or teratogenicity attributable to PAHs in the marine environment is limited. Studies have shown that caged blue mussels accumulate PAH; with levels decreasing with increasing distance from the discharge point (Sundt *et al*., 2008). Water column monitoring in the Dutch sector has shown an accumulation of the PAH naphthalene in blue mussels up to 1000 m from a platform (Foekema *et al*., 1998). Given the marine organisms' short exposure times, the overall risk posed by aromatic substances is very low (OGP, 2002).
- Alkylphenols - These are natural constituents of hydrocarbons found in oil entrained waters that can be toxic to marine organisms; as such they fulfil OSPAR criteria for potential persistence and bioaccumulation (OSPAR, 2009). Risk assessments undertaken on alkylphenols in produced water have indicated an insignificant risk on reproduction at the population level of cod, saithe and haddock (OGP, 2005). Sophisticated models consistently demonstrate that Predicted No Effect Concentrations are quickly attained into the water column, and that the exposure times of organisms to key contaminants are too short to induce a significant threat to marine ecosystems from contaminated fluid discharges (OGP, 2005).

Dilution in the water column

Compounds in residual fluids lost to sea 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. Rates of 30 to 100-fold occur within the first few tens of metres of the discharge point, and at distances 50 to 1000 metres of this point, rates of 1000 to 100,000 times are typical (OGP, 2005).

During the first hours after discharge, dilution is the predominant mechanism in concentration reduction. Similar entrained waste streams such as produced water present a 100-fold dilution factor within 50 metres 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 levels of contaminants discharged and the rapid dispersion in the environment, long-term or chronic effects are therefore very unlikely.

11.4.5 Pipeline construction materials

Pipelines in the Viking field have detailed component inventories. Pipeline construction includes the following materials: coal tar, plastic, steel and concrete (Costain, 2014d). Component parts have the potential to enter the marine environment through

deterioration and degradation over time. Short-term or long-term impacts from these materials are considered in detail in Section 9.

11.5 Short and Long-Term Impacts from Residual Contaminants

The impact of contaminants within the marine environment and that of sensitive receptors, for the purpose of this study, are separated into short-term/ immediate impacts (primarily caused by the physical decommissioning of the pipelines), and the long-term impacts associated with the degradation and deterioration of the pipelines decommissioned *in situ* over time.

11.5.1 Short-term impacts

On cutting the pipeline ends, it is anticipated that any trapped or entrained hydrocarbons will be slowly released, as the system is not pressurised. Owing to the small volume/ low concentration of hydrocarbons and the expected nature of release, it is expected that any hydrocarbons present will disperse within a short distance of the release point, and its impact will be short lived.

11.5.2 Long-term impacts

As the pipelines will be decommissioned *in situ*, it is anticipated that following cleaning of the pipelines some residual hydrocarbons, scale and sediments will remain *in situ.* This material will be released gradually after through-wall corrosion occurs and the integrity of the pipelines progressively fails. Any failure is anticipated to begin to occur after many decades (i.e., >60 years) (HSE, 1997, Costain, 2014d). Pathways from the pipelines to the receptors would be via the interstitial spaces in seabed sediments, overlying rock-placement where applicable and the water column. Release would therefore be gradual and prolonged such that the effects on the receiving marine environment are considered to be negligible. The potential chemical effects from degradation of the pipeline and its coatings are discussed in Section 9.

11.6 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 the discharge.

11.6.1 Plankton

Some localised toxicity to planktonic organisms may result from the release of fluids contaminated with entrained hydrocarbons during and after the proposed VDP1 and LDP1 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.

11.6.2 Benthic environment

The slow release of contaminated fluids has the potential to cause short-term toxicity or long-term impacts from harmful levels of bioaccumulation within the benthic community

(DTI, 2001). The extent of these impacts depends on water column depth, dispersion rates, current speed and dilution (Lee and Neff, 2011).

For both immediate or short-term impacts and long-term releases, it is anticipated that any contaminated fluids released during and after decommissioning activities at the VDP1 and LDP1 areas will dilute to levels that are too low to cause significant harm to benthic organisms. Therefore, it is unlikely that benthic organisms will be impacted.

The release of solid contaminants and their impacts on the benthic fauna can be reviewed in Section 9.

11.6.3 Fish and shellfish

As pelagic finfish are highly mobile, it is unlikely that there will be an impact on the finfish community. In a mesocosm study on the impacts of produced water on finfish, no negative impacts were observed (Gamble *et al*., 1987). There is a low probability of fish, shellfish or other epibenthic organisms being impacted by residual fluid or solid contaminants due to the expected low concentrations of hydrocarbons or chemical contaminants in the seawater.

11.6.4 Protected habitats and species

The VDP1and LDP1 infrastructure to be decommissioned is located within the North Norfolk Sandbanks and Saturn Reef SCI (Figure 4.2; JNCC, 2014a). Annex I habitats occurring within this SCI include sandbanks and biogenic reef habitats formed by the polychaete worm *S. spinulosa* (Table 4.3). Due to the hydrodynamic regime and the low volumes of residual fluids predicted, the short or long-term release of contaminated fluids or solids will have a negligible impact on either Annex 1 habitat (see section 9).

Annex II species sighted within the VDP1 and LDP1 decommissioning areas (UKCS Quadrants 48 and 49) include the harbour porpoise and the common seal. Sea Lampreys may also be present in the area. The short-term release of contaminated fluids or solids is unlikely to have an effect on any of the Annex II species noted. The low number of animals in the area, coupled with their high mobility suggests that no discernible impact on individuals or populations will be observed.

Long-term impacts on Annex 1 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 small number of individuals frequenting the area, the likely pathways of contamination and the mobile nature of the three species (sea lamprey, harbour porpoise and common seal).

11.7 Cumulative and Transboundary Impacts

The predicted small release of contaminated fluids during cutting operations is the only potential short term or immediate impact during the decommissioning process. As the discharge rates for oil in water are estimated to be in the region of 30 ppm following the cleaning and flushing regime, the impact to the local environment will be negligible and temporary. Therefore the potential for cumulative impacts is greatly reduced.

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. They have not however identified any negative environmental effects. 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).

ConocoPhillips believe that these decommissioning activities will not present a measurable cumulative impact to the local environment due to the following reasons:

- Regulatory requirements ensure that discharges to sea are limited with thresholds similar to those applied during production periods;
- Operators are required to reduce to as low as reasonably possible (ALARP), the opportunity for discharges to enter the marine environment; and
- 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*. Again 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. (See section 9 for further discussion.)

The VDP1 and LDP1 facilities are located 42 km west of the UK/ Norwegian 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.

11.8 Mitigation Measures

The key mitigation strategies proposed for the discharge streams highlighted in Section 11.3 are presented in table 11.2 below.

Table 11.2: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Residual hydrocarbons or solids in pipelines and subsea pipework	Cleaning of pipelines during the decommissioning process, including: • Flushing pipelines with sea water and gel pigging. • Re-injection of contaminated fluids from the gas pipelines. • Removal of any mobilised solid wastes for skip and ship. Disposal of waste transported onshore for disposal will be provided by an approved waste management contractor, in compliance with ConocoPhillips existing standards, policies and procedures. • Release of residual contaminants from the long-term degradation of the pipeline decommissioned *in situ*. • Release of degradation products from the breakdown of the pipelines. • A chemical risk assessment will be undertaken and operations permitted under the Offshore Chemicals Regulations 2002 (as amended).
Residual fluids in piggybacked methanol lines	• Cleaning of pipelines during the decommissioning process. • A chemical risk assessment will be undertaken and operations permitted under the Offshore Chemicals Regulations 2002 (as amended). • Wherever possible recovered clean methanol will be reused during Viking decommissioning operations. Disposal of waste transported onshore for disposal will be provided by an approved waste management contractor, in compliance with ConocoPhillips existing standards, policies and procedures.

11.9 Conclusions

For both the short-term/ immediate impacts during decommissioning operations, and during the long-term degradation of the pipelines decommissioned *in situ*, the release of residual fluids will result in negligible localised effects. These are not anticipated to have any discernible impact on the wider marine environment cumulatively or in combination with other activities.

12.0 ACCIDENTAL EVENTS

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

Three types of accidental event present the most likely worst-case impacts to the environment:

- Hydrocarbon release;
- Chemical spill; and
- Dropped objects.

The potential risk from one of these events is relatively similar for the proposed VDP1 and LDP1 decommissioning areas and as such both areas are examined together in the following sub-sections.

12.1 Regulatory Context

The consequences of potential oil or chemical releases from the proposed VDP1 and LDP1 decommissioning activities will be managed in accordance with current legislation and standards as detailed within Appendix A.

12.2 Hydrocarbon Releases - Approach

This sub-section examines the potential impacts of an accidental hydrocarbon release during the decommissioning of the VDP1 and LDP1 facilities.

12.2.1 Sources of potential impacts

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

The potential sources of hydrocarbon spillages from the VDP1 and LDP1 facilities have been identified through an Environmental Impacts Identification workshop, and the knowledge and experience developed from ConocoPhillips oil and gas operations in the North Sea. Based on this knowledge the following scenarios have been identified for the proposed activities:

- Blow-out from the condensate wells;
- Worst-case sinking of a vessel due to collision, releasing diesel to the sea;
- Diesel spill from a vessel;
- Loss of fluids from subsea structures or topsides;
- Accidental bunkering fuel (diesel or aviation) spillage during refuelling; and
- Diesel tank remedial loss.

Despite the small probability of a well blow-out or a vessel collision occurring and considering that the subsea infrastructure and topsides are expected not to contain

hydrocarbon fluids, the possibility of hydrocarbon spillages and the impacts on sensitive receptors have been investigated in detail in the following sections.

Oil behaviour at sea

When oil is released to the marine environment, it is subjected to a number of processes including: spreading, evaporation, dissolution, emulsification, natural dispersion, photo-oxidation, sedimentation and biodegradation (Table 12.1).

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

Hydrocarbon properties

The fate and effect of a spill is dependent on the chemical and physical properties of the hydrocarbons. Hydrocarbons used in, or produced by, the VDP1 and LDP1 fields include diesel, aviation fuel and condensate.

The VDP1 and LDP1 condensates specific gravities range from 0.766 to 0.804 and have APIs ranging between 53.23˚ and 44.5˚. Consequently these condensates are classified as ITOPF Group I oils (ConocoPhillips, 2014d and 2014e). Group I oils (non-persistent) tend to dissipate completely through evaporation within a few hours and do not normally form an emulsion (ITOPF, 2012).

Diesel and aviation fuel have very high levels of volatile components, evaporating quickly on release. The low asphaltene content in these fuels prevents emulsification, reducing persistence of them in the marine environment. Whilst diesel oil is a more persistent hydrocarbon than the condensate, its characteristics and subsequent behaviour when released means that it may not represent a significant threat to the environment when compared to a crude oil spill.

Table 12.1: Overview of the main weathering fates of oil at sea

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

Source: DTI, 2001.

12.2.2 Impact assessment and oil spill modelling

An accidental hydrocarbon release can result in a complex and dynamic pattern of pollution distribution and impact in the marine environment. As there are a variety of natural and anthropogenic factors that could influence an accidental spill, each spill is unique. Long-term effects reported range from none detected (e.g., after the Ekofisk blow-out in 1977) to chemical contamination but no acute biological effects detectable (e.g., after the wreck of the Braer in 1993) (DTI, 2001). The extent of an environmental impact of a spill depends on several factors including:

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

Overview of the modelling undertaken in the SNS operations and onshore operations Oil Pollution Emergency Plans (OPEPs)

Oil spill modelling has previously been undertaken for the VDP1 and LDP1 areas and is included within the SNS Operations and Onshore Operations Oil Pollution Emergency Plans (OPEPs) (ConocoPhillips, 2014d and 2014e).

In addition, a Viking Well Abandonments SNS OPEP Addendum was approved in March 2014 (ConocoPhillips, 2014f); however, the results are not relevant to this ES and were not considered further.

Condensate from the ConocoPhillips wells has not been fully characterised for use with either the Oil Spill Information System (OSIS) model or Oil Spill Contingency and Response (OSCAR) model, and so is not available within the models' oil databases. Because diesel is a more persistent hydrocarbon than condensate, diesel was used for the modelling (Table 12.2).

Those modelling scenarios relevant for the VDP1 and LDP1 decommissioning were extracted from the ConocoPhillips OPEPs (ConocoPhillips, 2014d and 2014e), and are summarised below with modelling inputs presented in Table 12.2.

- Scenario - Blow-out of the well nearest to the shoreline (Vulcan RD-05/02). This scenario represent a surface modelling done at the Vulcan RD-05/02, a well close to Vulcan UR, which will be decommissioned under LDP1 programme. Vulcan UR is also the closest well of the proposed activities to the UK coastline.
- Scenario - Loss of Platform Supply Vessel (PSV) bunker fuel and cargo diesel. This scenario represents a surface loss of diesel from a medium sized vessel at the location of the nearest well to the UK coastline, which is the Vulcan RD.
- Scenario - Loss of LOGGS export trunk pipeline to TGT inventory at LOGGS PR platform. This scenario has been modelled as an instantaneous surface spill of diesel from the LOGGS export trunk pipeline. DSV or a CSV, which are bigger vessels than a PSV, will be used during the decommissioning of VDP1 and LDP1 facilities. These vessels have a higher capacity in terms of diesel tank than the PSV. This scenario is used to represent a worst-case loss of diesel from a vessel's collision within the decommissioning area.

Table 12.2: SNS worst-case release modelling scenarios relevant to the decommissioning of VDP1 and LDP1 facilities

Scenario	Oil type (surrogate modelled)	Quantity/ flow rate	Release (hours)	Wind	Temp. (˚C)		Model type
					Air	Sea	
Blow-out of well nearest shoreline (Vulcan RD-05/02)	SNS condensate (marine diesel)	3.9 m³/day Total release: 58.5 m³	360	55˚	10	8	Deterministic
				290˚			Deterministic
				Annual Wind Rose			Stochastic
Loss of PSV bunker fuel and cargo diesel at asset nearest to UK shoreline (Vulcan RD)	Marine diesel	850 m³ Total release: 850 m³	Instant	35˚	10	8	Deterministic
				270˚			Deterministic
				Annual Wind Rose			Stochastic
Loss of LOGGS export trunk pipeline to TGT inventory at LOGGS PR platform	SNS condensate (marine diesel)	5,088 m³ Total release: 5,088 m³	Instant	35˚	10	8	Deterministic
				260˚			Deterministic
				Annual Wind Rose			Stochastic

KEY:
- 30 knots wind blowing towards nearest UK shoreline
- 30 knots wind blowing towards nearest international median line
- Annual average wind

Source: ConocoPhillips, 2014d and 2014e

The modelling results as presented in Table 12.3 suggest that deterministic and stochastic simulations for all the scenarios will not result in beaching or transboundary effects. Hydrocarbons will mainly be dispersed or evaporated.

The impact to the marine fauna and flora is considered to be localised and predominately occurs as toxic short term (temporary) effects. However, the diesel volume likely to be present during the proposed decommissioning of VDP1 and LDP1 is expected to be lower than the worst-case volume modelled, and so these results represent a highly conservative indication of the potential effects of an accidental hydrocarbon release.

12.2.3 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 oil spill. Socioeconomic and shoreline impacts are also described below.

Biological receptors

Although there is only a small likelihood of a hydrocarbon spill from VDP1 and LDP1, there is a potential risk to organisms in the immediate marine environment if a spill were to occur. The following section highlights the biological receptors that may be impacted from a potential oil spill incident. Table 12.4 summarises the potential effects of oil spills to marine life during the VDP1 and LPD1 decommissioning.

As the majority of potential spills are likely to be on the surface both planktonic and benthic communities are less likely to be influenced by an accidental spill. Other communities including fish, birds and marine mammals may incur more significant

impacts. For a description of the environmental sensitivities in VDP1 and LDP1 areas, please refer to Section 4.

Shoreline impact

The oil spill modelling undertaken for the OPEPs (ConocoPhillips, 2014d and 2014e) that are relevant for the VDP1 and LDP1 ES, do not predict that diesel spills will reach either the UK, Netherlands, Denmark, Belgium or French coastlines. In addition to these results, the actual hydrocarbon volume remaining on the platform following cessation of production activities is only residual so it is unlikely that this low volume may reach the coast in case of a spill. The volume of diesel that could potentially be released from a vessel is less than the worst-case modelled for the OPEP. Therefore the likelihood of a spill impacting the shore is considered negligible.

Table 12.3: SNS oil spill modelling results relevant for VDP1 and LDP1 areas

Scenario	Approximate Time		Likelihood of beaching (%)	Volume or mass[1]		
	First beaching (hours)	Crossing median line (hours)		Beached	Dispersed	Evaporated
Blow-out of well nearest shoreline (Vulcan RD-05/02)	Does not beach	Does not cross	-	0 m³	42 m³	30 m³
	Does not beach	Does not cross	-	0 m³	42 m³	30 m³
	Does not beach	-	0	-	-	-
Loss of PSV bunker fuel and cargo diesel at asset nearest to UK shoreline (Vulcan RD)	Does not beach	Does not cross	-	0 m³	508 m³	342 m³
	Does not beach	Does not cross	-	0 m³	506 m³	344 m³
	Does not beach	-	0	-	-	-
Loss of LOGGS export trunk pipeline to TGT inventory at LOGGS PR platform	Does not beach	Does not cross	-	0 t	0.2 t	608 t
	Does not beach	310	-	0 t	0.3 t	823 t
	-	-	-	-	-	-

KEY:

- 30 knots wind blowing towards nearest UK shoreline
- 30 knots wind blowing towards nearest international median line
- Annual average wind

Note: [1]The blow-out of the well nearest the shoreline and the loss of PSV bunker fuel and cargo diesel at asset nearest to UK shoreline scenarios have been modelled with OSIS which gives output in cubic meters. In comparison, the loss of LOGGS export trunk pipeline to TGT inventory at LOGGS PR platform scenario has been modelled with OSCAR which gives output in tonnes.

Source: ConocoPhillips, 2014d and 2014e.

Table 12.4: Summary of potential impacts to main biological receptors

Biological receptor	Effects and communities at risk
Plankton	Localised effects due to toxicity. Impacts on communities are unlikely due to natural variability, high turnover and seasonal fluctuation.
Benthos	The impact from the condensate or 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 subsurface release of condensate or the surface release of diesel will likely not impact benthic communities and therefore the risk is considered minimal.
Fish, spawning and nursery grounds	VDP1 and LDP1 are located within spawning grounds for nine species. The plaice spawning area within the vicinity of the VDP1 and LDP1 areas is considered to be a part of an important spawning area for this species, with a relative high intensity spawning recorded from ICES fish survey data (Ellis *et al.,* 2012; Coull, *et al.,* 1998; Section 4). VDP1 and LDP1 infrastructure also lies within the nursery grounds throughout the year for nine species (Ellis *et al.,* 2012; Coull, *et al.,* 1998; Section 4). 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	In VDP1 and LDP1 areas, the overall seabird vulnerability to surface pollution is “moderate” (JNCC, 1999). The most sensitive times of year are March and November when vulnerability to oil pollution is “very high” in some of the area. June and July data, where available, indicates “low” vulnerability and the remainder of the year ranges from “high” to “low” (Section 4). Physical fouling of feathers, damage to eyes and toxic effects of ingesting hydrocarbons can result in direct and indirect fatalities. Effects would depend on species present, their abundance, reliance on particular prey species and the time of year. Diving birds such as auks and gannets are particularly susceptible. Species most affected may be guillemots, razorbills and puffins that spend large periods of time on the water, particularly during the moulting season when they become flightless (DTI, 2001).
Marine mammals	The main cetacean (whale and dolphin) species occurring in the area of VDP1 and LDP1 (Quadrants 48 and 49) are white-beaked dolphin, white-sided dolphin and harbour porpoise, with sightings occurring throughout the year. Further species observed in the surrounding areas include minke whale, long-finned pilot whale, bottlenose dolphin and common dolphin (Reid *et al*., 2003; UKDMAP, 1998; Section 4). Potential effects may include inhalation of toxic vapours, eye/skin irritation and bioaccumulation. Ingestion of oil can damage the digestive system or affect liver and kidney function. Loss of insulation through fouling of the fur of young seals and otters increases the risk of hypothermia. Oil contamination can impact food resources directly through prey loss or indirectly through bioaccumulation. However it is expected that marine mammals would avoid the area if a spill were to occur.
Protected habitats and species	VDP1 and LDP1 infrastructure to be decommissioned is located within the North Norfolk Sandbanks and Saturn Reef SCI (JNCC, 2014a). Annex I habitats occurring within this SCI include sandbanks that radiate northeast parallel to the Norfolk coast. Also present are Annex I biogenic reef habitats formed by the polychaete worm *S. spinulosa* (Section 4). Annex II species sighted within the VDP1 and LDP1 decommissioning area (UKCS Quadrants 48 and 49) include the harbour porpoise, which has been sighted in very high numbers in August, in September in high numbers, and in March in moderate numbers. For the remaining months of sightings (February, April, May and October), the numbers of harbour porpoise were recorded as low, with no sightings recorded in January, June, July or December (Reid *et al*., 2003; UKDMAP, 1998). Common seals have been observed throughout Quadrants 48 and 49 (Jones *et al.,* 2013; Section 4).

Socioeconomic receptors

A number of sectors may be influenced by a potential spill from VDP1 and LDP1 decommissioning activities and are described in Table 12.5.

Table 12.5: Summary of main socioeconomic receptors

Receptor	Risks and Status at VDP1 and LDP1 Facilities
Fisheries	Fishing is one of the primary economic activities in the EU and it supports other shore-based activities including fish processing and boat construction. The impacts to offshore fishing 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. Moderate to low fishing activity occurs within the vicinity of VDP1 and LDP1. The UK landings from within the two ICES rectangles (35F1 and 35F2) containing the infrastructure to be decommissioned are relatively low. Within a 50 km radius of VDP1 and LDP1 infrastructure, fishing vessels predominately originate from the Netherlands. These vessels are primarily beam trawlers fishing for demersal species, including plaice (Section 4).
Tourism	Coastal tourism can be adversely affected by oil pollution events owing to reduced amenity value. Impact can be further influenced by public perception and media coverage. The offshore location of VDP1 and LDP1 facilities (>100 km) suggests that there is unlikely to be any impact on tourism.
Shipping	Shipping activity in the area of the VDP1 and LDP1 infrastructure ranges from moderate to high (DECC, 2014c; Section 4). 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.

12.2.4 Cumulative and transboundary impacts

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

Residual impacts

During removal operations, the loss of hydrocarbons contained within pipework, tanks and storage sumps may result in a small release which would cause a localised deterioration in water quality. ConocoPhillips will ensure that pipework, sumps and tanks in the topsides are emptied and cleaned during the EDC phase (Section 3). Any vessel receiving or handling the topsides will be equipped with its own Shipboard Oil Pollution Emergency Plan (SOPEP) to deal with minor releases and will have access to the ConocoPhillips OPEP and equipment.

The residual risk of environmental impact from accidental oil spills including discharge and release, during the decommissioning of VDP1 and LDP1 will be reduced to levels that are as low as reasonably practicable. This will be achieved by the preventive measures incorporated during design, operational control procedures and training. Even with these in place, there will still be a residual, albeit very low, risk of marine environment and/ or socioeconomic impact.

Cumulative impacts

Cumulative effects arising from the decommissioning activities at VDP1 and LDP1 areas have the potential to act additively with those from other oil and gas activity, including both existing activities and new activities, or to act additively with those of other human activities (e.g., fishing and marine transport of crude oil and refined products) (DTI,2004).

Any hydrocarbon discharge as a result of the decommissioning activity would be expected to disperse rapidly in the immediate environment without the potential to combine with other discharges from concurrent incidents. It is difficult to predict whether the impacts from an oil spill to the marine ecology of the affected area would be cumulative. This would depend on previous disturbances or releases at specific locations. Cumulative effects of overlapping "footprints" for detectable contamination or biological effects are considered to be unlikely. No significant synergistic effects are currently identified (DTI, 2004).

Transboundary impacts

There is a very low probability that a hydrocarbon spill would cross into international sectors such as the Netherlands, Belgium, Denmark or France sectors. Modelling predicts that diesel spill will only cross the median line in extreme conditions, i.e., continuous 30 knot wind blowing in the direction of the median line.

In the event of an oil spill entering the English Channel, it may be necessary to implement the Mancheplan (Anglo-French Joint Maritime Contingency Plan). Under the Bonn Agreement, the English Channel is a zone of joint responsibility between France and the UK. The Mancheplan covers counter pollution and rescue operations. The MCA Counter Pollution and Response Branch also have agreements with equivalent organisations in other North Sea coastal states, under the Bonn Agreement 1983. Applicable international arrangements are further described in Appendix A.

12.2.5 Mitigation measures

Mitigation and management primarily focus on preventing or minimising the probability of an accidental spill and secondly, reducing the consequences of the event through optimum and efficient containment and release response. During decommissioning, minor non-routine and emergency events such as minor leaks, drips and spills from machinery and hoses on the platform, from vessels or at onshore sites, could cause a localised 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 OPEPs (ConocoPhillips, 2014d and 2014e). Table 12.6 lists the planned measures to prevent or reduce the likelihood of a spill occurring during decommissioning of VDP1 and LDP1. Based on the estimated volumes of diesel and condensate, the ConocoPhillips 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 12.6: Oil spill preventative measures for likely scenarios during decommissioning

Potential source of impact	Planned mitigation measures
All oil spills	The inventories will be minimised prior to removal and transport to disposal yard. In addition, the use of pipeline capping for instance, could be stated to avoid a release during the transportation. The OPEPs have been produced in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002. The OPEPs detail responsibilities for initial response and longer term management, and will be updated as needed to reflect any change in operations and activities associated with decommissioning. There are three planned levels of response, depending on the 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. In addition, ConocoPhillips have specialist oil spill response services provided by OSRL and are members of the Oil Pollution Operator's Liability Fund (OPOL).
Vessel collision	Local shipping traffic would be informed of proposed decommissioning activities and a standby/ support vessel would monitor shipping traffic at all times.
Spill from a vessel beyond the 500 m exclusion zone	In the event of an accidental spill to sea, vessels will implement their SOPEP.

12.2.6 Conclusions

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

- Worst-case scenario at VDP1 and LDP1 areas would result from a loss of diesel from on-site vessels or collision;
- Condensate and diesel spills will disperse and dilute quickly, with no impact to coastlines;
- Probability of a hydrocarbon spill occurring is low and will not contribute to the overall spill risk in the area; and,
- OPEPs response will provide the direction to effectively manage the spill in case of an accidental event.

12.3 Chemical Releases - Approach

An accidental chemical release can result in a complex and dynamic pattern of pollution distribution and impact to the marine environment. The number of factors that could influence an accidental spill, both natural and anthropogenic, renders each spill unique. Potential sources of impact are presented in the following sections, and include a review of the sensitive receptors that may be influenced. In many cases, both impacts and receptors have been detailed in the hydrocarbon release section (Section 12). Where the chemical release impacts differ from those described in the hydrocarbon release section, they will be discussed in further detail.

12.3.1 Methodology

As part of the decommissioning process it is important to consider the magnitude of a potential chemical spill and assess the effects of such an unplanned event on key sensitive receptors.

12.3.2 Sources of potential impact

Technical failure remains the leading cause of chemical spills in the North Sea. The primary sources of loss to the environment are from spills of hydraulic fluids or chemicals. The potential sources of chemical spillages from the decommissioning of VDP1 and LDP1 have been identified through the Environmental Impacts Identification workshop and the knowledge and experience developed from ConocoPhillips and oil and gas industry operations in the North Sea (See Section 12.2.1). Based on this knowledge the following scenario has been identified:

- Accidental loss of fluids from subsea or topsides removal.

12.3.3 Impacts on sensitive receptors

Chemical release into the marine environment may impact sensitive receptors in different ways, depending on the following factors:

- Spill volume;
- Depth of release;
- Chemical toxicity;
- Chemical solubility;
- Persistence in the environment;
- Biodegradability of the compound;
- Potential for bioaccumulation in the food chain; and
- Partitioning of individual components.

Biological receptors

Section 4 and Table 12.4 provide a comprehensive description of the biological receptors in VDP1 and LDP1 areas sensitive to potential chemical spills. Due to the rapid dispersion and dilution of chemicals upon discharge or release, few biological receptors are noticeably impacted. The most sensitive receptors are the planktonic communities.

Plankton (phytoplankton, zooplankton and fish larvae) are likely to come into direct contact with discharged chemicals, with zooplankton appearing to be the most vulnerable particularly at the early stages of development. However, the impact of a chemical spill is not likely to impact beyond the immediate vicinity of the discharge point because:

- The likely credible maximum volume of chemicals that may be subject to a spill event would be very low;
- Discharge is likely to be dispersed and diluted rapidly by the receiving environment;
- Many of the compounds are volatile or soluble and are removed from the water by evaporation and dilution; and,
- Biological Oxygen Demand (BOD) is likely to be within the capacity of ambient oxygen levels.

Socioeconomic receptors

The main socioeconomic receptors relevant to a hydrocarbon spill are presented in Table 12.5 and in most cases; this information is also pertinent to chemical spills. Dispersion, dilution and potentially very small volumes spilt will result in localised impact areas. No significant socioeconomic impacts are foreseen for fisheries, tourism, oil and gas, or shipping.

12.3.4 Cumulative and transboundary impacts

The majority of chemical spills are unlikely to result in an environmental impact due to a combination of rapid dispersion and dilution of the chemicals and the depth and distance from shore (>100 km) of the VDP1 and LDP1 infrastructure. The potentially spilt volumes are unlikely to pose any noticeable risk to residual, cumulative or transboundary impacts.

12.3.5 Mitigation measures

The impacts of all the chemicals that may be used or discharged offshore during decommissioning will be assessed and reported to DECC in a relevant Portal Environmental Tracking System (PETS) application. Chemicals in pipelines will be flushed and returned to the platform for disposal under appropriate permits.

The proposed mitigation measures to reduce the likelihood of chemical spills to the environment are presented in Table 12.7.

Table 12.7: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Chemical spills from VDP1 and LDP1 decommissioning activities	• ConocoPhillips will conduct all operations in a controlled manor with trained personnel using suitable equipment. All vessels will have suitable skill kits and an efficient spill response process is in place. • ConocoPhillips routinely swap out perishable equipment such as hoses, and is implemented by a management programme in order to ensure their integrity. • Prior to transfer, visual checks are undertaken by trained personnel in communication with the standby vessel. • Observed leaks are reported and dealt with immediately by competent personnel and reported to the appropriate authorities.

12.3.6 Conclusions

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

- Chemical spills will disperse and dilute quickly, with only localised effects to planktonic communities;
- Probability of a chemical spill occurring is low and will not significantly add to the overall spill risk in the area.

12.4 Dropped Objects - Approach

There is the potential for the loss of objects during the decommissioning process. Depending on the size of the objects they may present a hazard to shipping and subsea infrastructure, and to fishing activities such as trawling. Dropped objects may also impact on the seabed community within the drop zone. Dropped objects can vary in size from tools to large sections of topsides infrastructure or the loss of a vessel.

An investigation of the status of the seabed debris will be undertaken during the pre-decommissioning surveys for rig and AWV positioning.

12.4.1 Sources of potential impact

The likely worst case scenario which imposes the greatest environmental and socioeconomic impact for a dropped object would be the loss of a large section of jacket or topsides from the removal phase of the project. As a result of an accident, in extreme circumstances, a section of the upper jacket or topsides could fall to the seabed during the latter stages of the cutting operations, or whilst being transferred to a vessel.

This type of event may cause localised effects in the water column, on the seabed or to the benthos. The extent and severity of these effects would depend on the object lost and the amount of seabed and sediment disturbed.

12.4.2 Impacts on sensitive receptors

Potential impacts on biological and socioeconomic receptors from of an accidental dropped object are described in the following paragraphs.

Biological receptors

In the event of a dropped object, the dominant receptors are the infaunal and epibenthic communities within the drop zone. Comprehensive surveys have provided a detailed description of the resident benthic community below VDP1 and LDP1 facilities. Recent surveys have also allowed a comparison of community composition against historical surveys undertaken during the operational life of the field. Section 4 presents a summary of the project specific surveys undertaken. Whilst the impact of a dropped object on the immediate drop zone may be significant, the effect is likely to be localised. The benthic community beyond 500 m from VDP1 and LDP1 infrastructure is indicative of and comparable in diversity and composition with surrounding areas of the North Sea (as detailed in Section 4). Therefore the impact of a dropped object would have no significant impact on the wider community. No other biological receptors will be impacted by a dropped object.

Socioeconomic receptors

There is a potential to transport the jackets overboard of the HLV which would require passing above live pipelines. However, the probability that a jacket would be lost above a live pipeline is very low.

In addition, any dropped objects will be recovered during decommissioning operations and an independent seabed debris clearance and overtrawlability survey conducted once decommissioning operations have been completed to verify that a clean seabed has been left (excluding infrastructure that is expected to remain in place).

No impacts relating to other socioeconomic receptors have been identified from dropped objects.

12.4.3 Cumulative and transboundary impacts

In case of a potential loss of objects during the decommissioning process, the impacts will be temporary and will only cause disturbance to a very localised area of seabed and the associated water column. They will not have any residual effects and will not contribute to cumulative or transboundary impacts.

12.4.4 Mitigation measures

Appropriate mitigation measures in the event of a dropped object should be implemented during the proposed VDP1 and LDP1 decommissioning operations (Table 12.8).

Table 12.8: Planned mitigation measures

Potential source of impact	Planned mitigation measures
Dropped object event from VDP1 and LDP1 decommissioning activities	• Where practicable all efforts will be made by ConocoPhillips to minimise the number of dropped objects. During the cleaning and preparation for removals programme, items will be secured to prevent loss wherever practicable. • Post-decommissioning surveys will be undertaken to assess the presence and potential recoverability of any lost objects from VDP1 and LDP1 infrastructure wherever practicable. The recovery of such debris will be undertaken to minimise the impact on the environment and to minimise the risk to other users of the sea wherever possible.

12.4.5 Conclusions

The conclusions from the impact assessment for a dropped object include:

- Worst case scenario would be the loss of a major portion of the jacket and topside during lifting operations;
- Depending on the size of the item, dropped objects may present a hazard to shipping and subsea infrastructure and fishing activities such as trawling; and,
- Post decommissioning surveys will provide locations of dropped objects and assist in their removal where practicable.

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13.0 WASTE

Decommissioning activities will generate quantities of controlled waste, defined in Section 75(4) of the Environmental Protection Act 1990 as household, industrial and commercial waste or any such waste. The sequence and quantities of controlled waste generated at any one time will depend on the processes used for dismantling and the subsequent treatment and disposal methods.

Three key challenges are associated with waste management for the VDP1 and LDP1 infrastructure.

- Generation of large quantities of controlled waste within short timeframes. This will require detailed planning to manage the logistics associated with the transport to shore, temporary storage and onward treatment/ disposal of materials.
- Potential for “problematic” materials, generated due to cross–contamination of non-hazardous waste with substances that have hazardous properties, which results in the material being classified as hazardous waste. Hazardous waste is defined as material that has one, or more, properties that are described in the Hazardous Waste Directive (91/689/EEC) as amended by Council Directive 94/31/EC.
- Problems associated with materials with unknown properties at the point of generation. These quantities of ‘unidentified waste’ require careful storage and laboratory analysis to determine whether they are hazardous or non-hazardous waste.

In accordance with the DECC Guidance Notes under the Petroleum Act 1998 (DECC, 2011a), the disposal of such installations should be governed by the precautionary principle. ConocoPhillips will assume the worst-case, especially when dealing with hazardous and unidentified wastes, and choose waste treatment options which would result in the lowest environmental impact.

13.1 Waste Generation

ConocoPhillips will follow the principles of the waste hierarchy as described in section 13.3. Typical non-hazardous waste will include scrap metals (steel, aluminium and copper), concrete and plastics that are not cross-contaminated with hazardous waste and can therefore be removed and recovered for reuse, recycling or landfill. Hazardous waste will include oil contaminated materials and chemicals. Many types of hazardous waste generated during decommissioning are routinely generated during production and maintenance of offshore installations. However, the decommissioning process may generate significantly greater quantities of both non-hazardous and hazardous waste when compared to routine operations and as such requires appropriate management.

An estimate of the different types of materials and quantities in the VDP1 and LDP1 infrastructure to be decommissioned, are detailed in Section 3, Tables 3.15 and 3.16 respectively.

13.1.1 Radioactive waste

Radioactive wastes including sources (e.g. smoke detectors) and NORM associated with pipework and sand from vessels will be managed in line with current legislative requirements (Appendix A). The Environmental Permitting (England and Wales) Regulations 2010 (as amended) regulates the handling, storage, transfer and disposal of such waste. ConocoPhillips has an existing procedure in place for managing radioactive waste and the local rules for working with radioactive materials will be revised to include

the removal and transportation of radioactive materials during decommissioning in consultation with the relevant authority depending on the location of disposal/ treatment site. ConocoPhillips will work to current NORM procedures in existence for SNS Operations (ConocoPhillips, 2015a; ConocoPhillips, 2015b).

13.1.2 Wastes generated during Engineering Down Cleaning (EDC)

During EDC, all topside systems will be depressurised, purged, flushed and rendered safe for removal operations. Pipework and tanks will be drained to remove sources of potential spills of oils and other fluids. Diesel and lubricating oils will be drained and returned to shore for disposal. Mobilised solids filtered from the pipeline flushing will be removed and sent to a fully permitted onshore treatment facility.

13.2 Regulatory Context

There is no waste related legislation that specifically covers decommissioning activities, however some aspects of existing waste legislation are relevant (Appendix A).

Whether a material or substance is 'waste' is determined by EU law. The EU Waste Framework Directive (WFD) (2006/12/EC) defines 'directive waste' as "*any substance or object in the categories set out in Annex I of the Directive which the holder discards or intends or is required to discard*". Annex I provides a list of definitions and includes a general category – "Any materials, substances or products which are not contained in the above categories".

The responsibility for waste management lies with the producer or duty holder to decide whether a substance or object is waste. The action of removal and transfer of redundant installations and infrastructures to shore falls within the legal definition of waste; and the responsibility for determining whether a substance or object is waste lies with the Operator.

Having determined the substance or object is waste, subsequent storage, handling, transfer and treatment of the waste generated is then governed by a number of regulations. A breakdown of the legislation is available in Appendix A.

If the selected disposal yard is in a country outside of the UK, the waste will be dealt with in line with the receiving countries waste legislation.

13.3 Waste Management

The waste hierarchy is a conceptual framework which ranks the options for dealing with waste in terms of their sustainability (Figure 13.1). For the onshore treatment and disposal of VDP1 and LDP1 material, ConocoPhillips will follow the principles of the waste hierarchy in order to minimise waste production.

The waste hierarchy is a key element in OSPAR Decision 98/3 and DECC Guidance Notes (2011) and requires that the decommissioning decisions are consistent with the waste hierarchy. ConocoPhillips recognises that, in line with the waste hierarchy, the reuse of an installation is first in the order of preferred decommissioning options. However, as the majority of the VDP1 and LDP1 facilities are obsolete and/ or in a degraded condition, they are not considered suitable for safe re-use. The majority of jacket and topside material will therefore be recycled with pipelines decommissioned *in situ*. ConocoPhillips do however intend on cutting all pipelines at the satellite end and fully removing the T-piece at the Vampire OD Platform. In order to do this, ConocoPhillips may have to remove concrete mattresses and grout bags. Although the

quantity of this material is currently unknown, it will be fully quantified in future consent applications. A small number of mattresses may also be removed to gain access to sever the pipeline at the satellite platforms, the exact quantities will be detailed in subsequent consent applications.

Source: http://www.sepa.org.uk/waste/moving_towards_zero_waste/waste_hierarchy.aspx

Figure 13.1: The waste hierarchy

Non-hazardous materials, such as scrap metal, concrete, and plastics not contaminated with hazardous waste, will be removed and, where possible, be reused or recycled (with the exception of the pipelines remaining *in situ*). Other non-hazardous waste which cannot be reused or recycled will be disposed of to a landfill site. Steel accounts for the greatest proportion of materials inventory from the VDP1 and LDP1 platforms.

Where necessary, hazardous waste resulting from the dismantling of the VDP1 and LDP1 facilities will be pre-treated to reduce hazardous properties or, in some cases, render it non-hazardous prior to recycling or landfilling. Under the Landfill Directive, pre-treatment will be necessary for most hazardous wastes which are destined to be disposed of to landfill site.

Table 13.1 and Table 13.2 outline the fate of decommissioned material for VDP1 and LDP1 respectively, while Figure 13.2 represents the ideal disposal routes for materials.

Table 13.1: Proposed fate of VDP1 materials

Infrastructure	Facility	Recommended decommissioning option	Destination
Jackets	Five jackets	Removal (single lift)	Recycling
Topsides	Five topsides	Removal (single lift)	Recycling
			Recondition and re-use
			Waste to energy
			Landfill
			Treatment for NORM (contaminated pipework)
Pipelines	Five x 2” MeOH pipelines	Decommission majority *in situ* and remove pipeline ends by cut and lift	Decommissioned *in situ*
	Five x 12” gas pipelines		Recycling (pipeline ends)
			Treatment for NORM (pipeline ends)
			Landfill (pipeline ends)

Table 13.2: Proposed fate of LDP1 material

Infrastructure	Facility	Recommended decommissioning option	Destination
Jackets	Three jackets	Removal (single lift)	Recycling
Topsides	Three topsides	Removal (single lift)	Recycling
			Recondition and re-use
			Waste to energy
			Landfill
			Treatment for NORM (contaminated pipework)
Pipelines	Three x 2” MeOH pipelines	Decommission majority *in situ* and remove pipeline ends by cut and lift	Decommissioned *in situ*
	Three x 12” gas pipelines		Recycling (pipeline ends)
			Treatment for NORM (pipeline ends)
			Landfill (pipeline ends)
Subsea infrastructure	T-piece	Removal (cut and lift)	Recycling

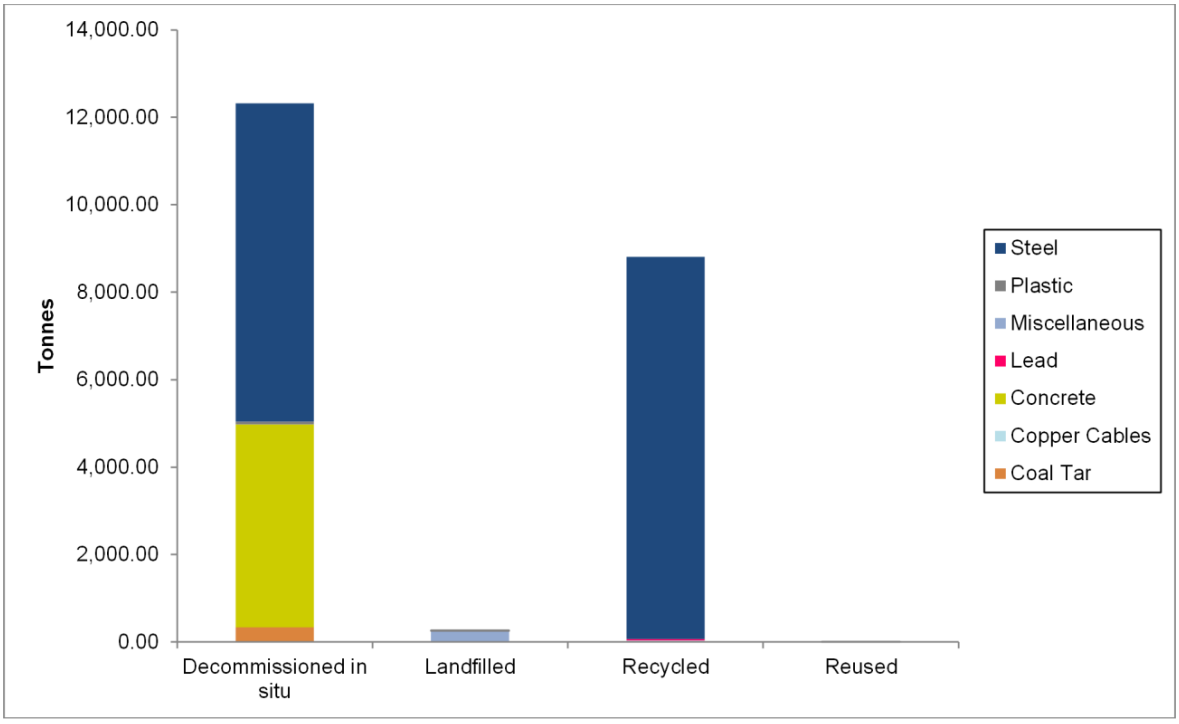

Figure 13.2: Bar chart of the estimated tonnage and predicted disposal routes of decommissioned material

Figure 13.3 and Figure 13.4 show the estimated percentages of material expected to be disposed of in landfill, recycled, reused, decommissioned *in situ* and for further treatment/ incineration. The majority of pipeline materials are likely to be decommissioned *in situ* with jackets and topsides being largely recycled. Only a small amount of material, < 300 tonnes in total, is expected to be sent to landfill. The estimated quantities of materials currently expected to be sent for reuse are small and have therefore been omitted from the figures. Two platform topsides (Vampire OD and Viscount VO) may also be candidates for larger-scale or complete re-use by other operators, but have been included here in the material to be sent for recycling or to landfill to represent a worst-case scenario.

The management of waste generated from operations and drilling activities has been addressed by ConocoPhillips through an ISO14001 certified Environmental Management System (EMS) (as presented in Section 14). The EMS includes a documented procedure for waste management which is designed to ensure that all waste generated during the ConocoPhillips offshore production and drilling operations are managed according to the Company's HSE policy and relevant legislation.

Specifications to manage the waste generated during decommissioning will conform to the requirements of the ConocoPhillips EMS (ConocoPhillips, 2015c) as follows.

- Undertake a review of the EMS and update it to ensure that significant environmental impacts and legislative requirements, as a result of waste generation and treatment during decommissioning, are adequately recorded and assessed, and any requirements for operational controls or other management actions are identified.
- Prepare a Waste Management Plan for the Decommissioning Programmes.

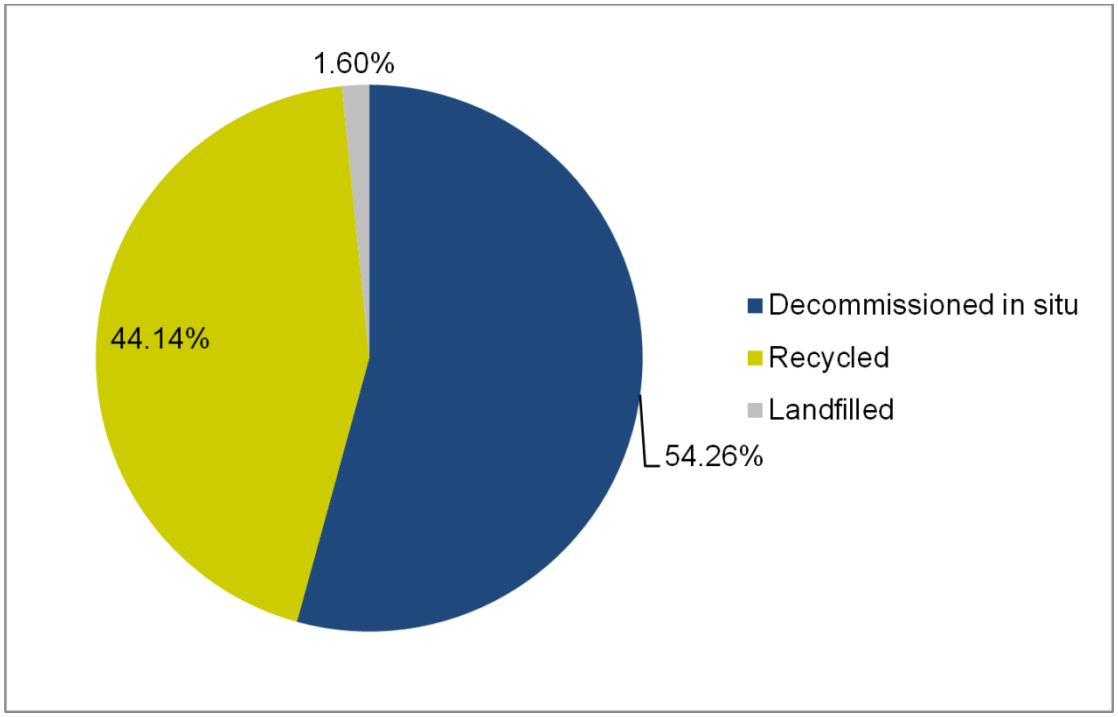

Figure 13.3: Pie chart of estimated material disposal route percentages for VDP1 infrastructure

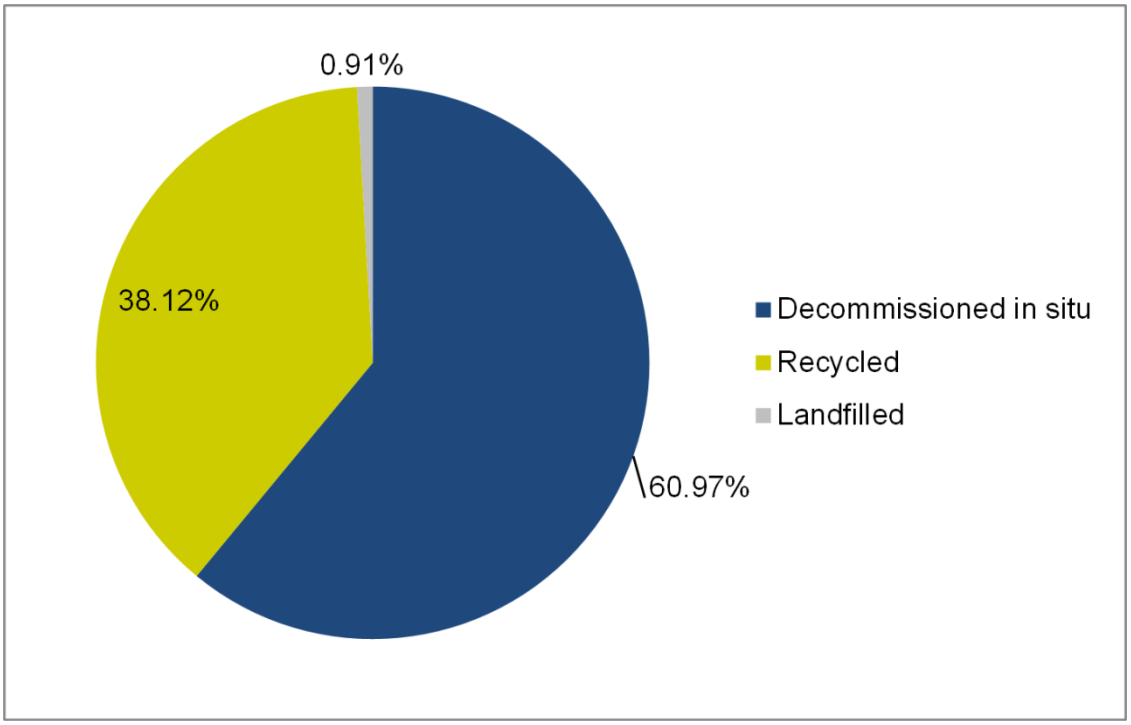

Figure 13.4: Pie chart of estimated material disposal route percentages for LDP1 infrastructure

13.3.1 Environmental management system

Sustainable Development is a key consideration when conducting business. For ConocoPhillips this is about conducting business while promoting economic growth, a healthy environment and vibrant communities, now and into the future. The ConocoPhillips world-wide and UK Health Safety and Environmental Polices are implemented in the UK through an independently verified Environmental Management System (EMS) which covers all activities carried out by ConocoPhillips both onshore and offshore. The underlying policies, processes and EMS are described in more detail in Section 14.

13.3.2 Contractor management

Waste management activities include the handling, storage and treatment of waste offshore, the transfer of waste to a waste treatment or dismantling yard for further storage, handling and treatment as appropriate, and then further transfer to the final disposal or treatment point. These activities will be conducted by contractors and sub-contractors on behalf of ConocoPhillips using their own waste management system. The waste contractors/ sub-contractors will also undertake all necessary paperwork including the tracking of wastes, accounting and identification of wastes, wastes generated per asset and waste segregation. Although ConocoPhillips will not be undertaking the actual physical work, the legal liability, i.e., Duty of Care, for all waste generated from decommissioning remains with ConocoPhillips for the duration of the programme.

The selection and management of contractors by ConocoPhillips is managed through the contractor control processes and procedures. Specific targets to maximise re-use and recycling, minimisation of waste to landfill, and the use of innovative solutions with contractors/ sub-contractors would be agreed at this stage and included in the disposal yards contract. Specific actions to support the management and minimisation of waste generated by contractors during decommissioning will include:

- Ensuring that waste management issues are covered within the contractor interface documents; and
- Engaging with contractors to identify effective technical solutions that support waste minimisation with the reuse and recycling of waste, if possible.

The procedures and processes for waste and contractor management will be embedded in the EMS, detailing actions, roles and responsibilities of personnel from within ConocoPhillips and the various contractors working on an individual decommissioning project. Specific audit/ monitoring schedules will be set up as part of the disposal yard contract award and will comply with the ConocoPhillips Corporate Waste Disposition Standard.

13.3.3 Measuring and monitoring performance

Measuring and monitoring performance is an important element of an EMS (ConocoPhillips, 2015c) and ConocoPhillips already has a number of mechanisms in place to do this. With respect to the management and minimisation of waste during the decommissioning of the VDP1 and LDP1 facilities, the key areas for action are as follows:

- Monitoring legislative compliance; and
- Measuring performance against stated targets.

A range of methods will be used to ensure effective monitoring of waste management activities including, for example, auditing of contractors and disposal sites, monthly waste statistic summaries and the use of disposable yards materials tracking tools.

14.0 ENVIRONMENTAL MANAGEMENT

The ConocoPhillips world-wide and UK Health Safety and Environmental Policies are implemented in the UK through an independently verified EMS which covers all activities carried out by ConocoPhillips both onshore and offshore. This meets the requirements of OSPAR Recommendation 2003/5 which promotes the use and implementation of EMSs by the offshore industry. VDP1 and LDP1 activities will be carried out in accordance with the ConocoPhillips EMS (ConocoPhillips, 2015c).

This section introduces relevant ConocoPhillips corporate policies and details, the means by which ConocoPhillips will manage the environmental aspects of the VDP1 and LDP1 decommissioning activities. This section catalogues the commitments made in support of the decommissioning proposals and provides a delivery mechanism for these commitments.

14.1 Health, Safety and Environmental Policy

ConocoPhillips takes all reasonable precautions to achieve the goal of harm-free operations. The ConocoPhillips HSE Policy (Figure 14.1) presents the company's public commitment to conducting business in a manner that protects the health and safety of people and preserves the integrity of the environment within which it operates. It is endorsed by top management who are responsible for ensuring its implementation. Line managers have primary responsibility for ensuring compliance with the Policy and for effective communication of the policy commitments and requirements to their staff.

The HSE Management System Standard provides corporate expectations for the business' HSE Management System which is the primary tool used to execute the commitments made in the HSE Policy. The HSE Management System adheres to a continuous improvement lifecycle and includes key elements such as risk assessment, incident and near miss reporting and investigation, HSE training, audits and annual review and goal setting.

ConocoPhillips

U.K. HSE Policy

Policy Statement Commitment

ConocoPhillips (U.K.) Limited is committed to protecting the health and safety of everybody who plays a part in our operations or lives in the communities in which we operate. Wherever we operate, we will conduct our business with respect and care for both the local and global environment and will systematically manage risks to drive sustainable business growth.

We will not be satisfied until we succeed in eliminating all injuries, occupational illnesses, unsafe practices and incidents of environmental harm from our activities.

Organisation and Responsibilities

The ConocoPhillips U.K. President has overall accountability for the Health, Safety and Environmental (HSE) performance of our U.K. operations.

Health, Safety and Environmental staff with reporting lines to senior management are appointed at various locations throughout the Company. These personnel are responsible for providing advice and guidance on matters relating to the health, safety and welfare of employees and on environmental matters.

All managers and supervisors at ConocoPhillips are responsible and accountable for the health and safety of their staff by:

- Ensuring that all applicable Health, Safety and Environment legislation and codes are adhered to and that appropriate actions are taken to ensure a safe working environment.
- The active participation of all employees in the achievement of Health, Safety and Environmental objectives.
- Conducting all activities in accordance with the requirements of the Operating Management System (OMS).

Employees are responsible for ensuring they comply with relevant legislation and the OMS, to ensure prevention of harm to themselves, their colleagues and the environment.

Arrangements

To meet our Policy Statement, ConocoPhillips (U.K.) Limited will:

- Demonstrate active Health, Safety and Environmental leadership and communication of this policy.
- Comply with relevant laws, regulations and applicable codes
- Provide medical services to give advice, guidance, support and monitoring on health-related matters.
- Include environmental considerations in our business decisions and minimise the impacts of our activities on the environment.
- Require all employees and contractors to attend periodic health, safety and environmental meetings.
- Ensure that all employees and contractors understand that working safely is a condition of employment, and that everyone is responsible for their own safety and for minimising environmental impacts of our operations.
- Manage all projects and processes through their life cycles in a way that protects health and safety, prevents pollution and manages wastes.
- Develop safe systems of work for all potentially hazardous situations; identify and assess major accident hazards.
- Implement procedures to ensure that integrity and reliability issues, which have the potential to cause an HSE impact, are properly considered at all stages in the asset life cycle.
- Provide employees, contractors and suppliers with the training, knowledge and resources necessary to achieve our Health, Safety and Environmental commitments.
- Provide effective emergency response systems allowing onshore and offshore personnel to deal effectively with emergency situations.
- Measure, audit and publicly report Health, Safety and Environmental performance and maintain open dialogue with stakeholder groups.
- Promote and adhere to the ConocoPhillips Life Saving Rules
- Work with the regulator and other stakeholders to continuously improve Health, Safety and Environmental performance.

..... **Dominic Macklon**, President U.K.

Our work is never so urgent or important that we cannot take the time to do it safely and in an environmentally responsible manner

UK-00655 August 2015

Figure 14.1: ConocoPhillips HSE Policy Statement

14.2 The ConocoPhillips HSE Management System

ConocoPhillips' environmental policies have the underlying principle of conducting business with respect and care for the environment in which the company operates. ConocoPhillips implements such policies through an environmental management system (EMS) (ConocoPhillips, 2015c).

The ConocoPhillips (U.K.) Health Safety and Environmental (HSE) Policy provides a framework for the integrated management of environmental issues related to the company's U.K. business activities. It commits the company to comply with environmental legislation and strive for continuous improvement in environmental performance.

ConocoPhillips (U.K.) has implemented a dedicated environmental management process that is fully integrated within its Deming Cycle-based Operating Management System (OMS) (Figure 14.2).

The OMS provides the governance by which the company's HSE Policy is implemented throughout our operations.

The environmental management process has been designed to meet the requirements of the corporate and global HSE Management System Standard, utilising the requirements and principles contained in the internationally recognised environmental management systems standard ISO 14001:2004.

ConocoPhillips gained company-wide certification to ISO 14001 in 2002 and re-certification in September 2015.

Figure 14.2: Deming Cycle-based Operating Management System (OMS)

14.3 Environmental Aspects

The Environmental Aspects Register is a comprehensive listing of environmental aspects and their associated impacts arising or likely to arise, from company activities, products and services (existing and planned), including:

- Emissions to atmosphere (controlled and uncontrolled);
- Discharges to sea and surface water and sewers (controlled and uncontrolled);
- Seabed disturbance (impacts in protected habitats);
- Offshore Noise (seismic survey and piling noise and the potential impacts on marine mammals and fish species);
- Impacts to land (waste disposal and other waste with potential for contamination);
- Resource consumption (use of land, water, fuel / energy, raw materials);
- Social and socio-economic;
- Community issues (onshore) (noise, vibration, dust, odour, and visual impact); and
- Non-Routine Events (spills and emissions).

The Register and significance scores can be viewed by ConocoPhillips U.K. personnel at all U.K. locations via the company intranet. Areas requiring improvement are subject to annual environmental goals, which are cascaded down through the organisation from company level, through the Business Unit down to specific asset, workgroup and individual employee level. Provision is made within the system to allow goals and programmes to be generated at the operating asset level also. Improvement programmes allow the company to assign resources to meet any environmental targets set and to operate in an environmentally responsible way.

Environmental aspects related to VDP1 and LDP1 will be integrated into the existing ConocoPhillips Environmental Aspects Register.

14.4 Register of Commitments

ConocoPhillips is committed to minimising the environmental impact of its activities. Continuous improvement in environmental performance is sought through effective project planning and implementation, emission reduction, waste minimisation, waste management and energy conservation.

A Register of Commitments has been developed to address the overall activities of VDP1 and LDP1 (Table 14.1) and are in addition to the mitigation measures identified during the EIA process. This register along with the proposed mitigation measures will form part of the decommissioning project planning process, and will be integrated into the relevant phases. The mitigation measures and commitments will also be embedded into the following documents to ensure appropriate execution and management:

- Detailed engineering specifications;
- Contracts; and
- Execution plans.

Table 14.1: Register of commitments

Issue	Commitment
Delivery of commitments	The commitments made within this ES will be incorporated into operational work programmes, plans and procedures. Programmes will be tracked to ensure that commitments and mitigation measures are implemented throughout the project.
Management responsibilities	Key environmental responsibilities, duties, communication, reporting and interface management arrangements of ConocoPhillips and the main contractors involved in the decommissioning activities will be agreed, documented and communicated at the appropriate stages of the project.
Commitment to the environment	ConocoPhillips will work to minimise short and long term impacts from their decommissioning operations.
Post decommissioning	ConocoPhillips will undertake post decommissioning surveys (scope and frequency to be discussed and agreed with DECC).
Legacy issues	In consultation with DECC, ConocoPhillips will endeavour to address any material environmental issues identified as requiring positive action regarding man-made infrastructure decommissioned *in situ*.

14.5 Roles and Responsibilities

The roles and responsibilities of ConocoPhillips, contractors and subcontractors will be clearly identified and the interrelationship between these entities defined. As contracts are awarded the organisational chart will be updated and evolve to incorporate amendments to the project phases, then managed accordingly.

14.6 Contractor Interface

Contractor management is an integral part of ConocoPhillips UK HSE Policy and contractors are expected to demonstrate a high level of HSE commitment and have systems in place for managing Health, Safety and Environmental issues.

The ConocoPhillips UK HSE policy requires contractors to attend periodic Health, Safety and Environmental meetings and ensure an understanding that working safely is a condition of employment, and that everyone is responsible for their own safety and for minimising environmental impacts. The necessary training, knowledge and resources are supplied to contractors by ConocoPhillips in order to meet company HSE commitments.

At the project level, all offshore contractors involved in the decommissioning of facilities must produce procedures for all aspects of the decommissioning activities; these procedures are subject to HAZIDs and procedural Hazard and Operability (HAZOP) assessment. Appropriate measures are introduced where necessary to ensure acceptable levels of safety and environmental protection. All Contractors are responsible for all aspects of national and international regulatory compliance with regard to their activities and equipment, including international pollution prevention measures.

Contractor interface documents will be developed to manage environmental commitments during decommissioning. The interface document will detail the management organisation, the communication and reporting lines and the division of responsibilities during operational and emergency situations.

14.7 Staff Training and Awareness

Environmental training is undertaken by all ConocoPhillips staff involved in activities that have the capacity to create a significant environmental impact. The training ensures competency to perform work in compliance with ConocoPhillips Environmental Policy

and individual responsibilities. Records of environmental training are kept as part of asset level EMS documentation.

Training and competency are managed through individual contracts and ConocoPhillips stipulating minimum standards of training and competency that are required for personnel to undertake work on ConocoPhillips' behalf. These comprise industry standard training/ awareness and technical standards. Compliance with this is demonstrated at regular performance reviews. Contractors are also independently audited regularly with training and competency forming a key part of these audits.

14.8 Environmental Monitoring

Decommissioning operations will be conducted under the relevant licences and permits applied for by ConocoPhillips. Monitoring and reporting to the regulator and internally will be conducted in accordance with relevant legislation and these licences. For example, discharges to sea from chemicals and residual hydrocarbons will be permitted appropriately and any accidental discharges to sea will be reported and investigated through ConocoPhillips's incident investigation process.

ConocoPhillips have arrangements in place for monitoring environmental performance and compliance with legislation, company policy, standards and procedures. Two approaches to monitoring are applied: active (providing feedback on performance) and reactive (providing information on incidents, accidents and near misses). Appropriate performance measures will be established for monitoring progress towards the achievement of defined goals and targets, and appropriate arrangements will be in place to ensure the effective collation and reporting of this performance data.

Through the execution of the HSE Management System Standard, a variety of deliverables are generated by ConocoPhillips. These include investigation reports of "high and significant risk" incidents, audit findings and HSE Compliance Verification Reports. A monthly report highlighting HSE performance is communicated electronically via the company intranet, which is accessible to all employees. Both the ConocoPhillips Management Committee and Public Policy Committee of the company's Board of Directors receive updates of HSE issues, events and performance from the HSE VP.

14.9 Performance Monitoring (Inspection, Audit and Corrective Actions)

Monitoring will be performed by internal and external parties. The scope and frequency of internal monitoring depends on an assessment of risks performed by line managers, process owners and corporate staff functions. Internal monitoring consists of three main categories: follow-up, verification, and internal audit.

ConocoPhillips maintains a multi-tiered risk-based HSE audit programme encompassing regulatory and management system compliance audits at both the corporate and business unit levels. The programme also includes external insurance risk assessments. Independent, limited assurance audits of ConocoPhillips' corporate level processes for collating and reporting aggregated HSE data presented in ConocoPhillips' Sustainable Development report are also commissioned. Auditing associated with decommissioning will be identified and scheduled in the ConocoPhillips Audit Programme prior to and during ongoing decommissioning operations.

15.0 CONCLUSIONS

Environmental Impact Assessment forms an integral part of the ConocoPhillips Environmental Management process, ensuring that adequate environmental considerations are incorporated into both of the decommissioning programmes, VDP1 and LDP1.

This ES presents the findings of the EIA for the recommended options for the decommissioning of the VDP1 and LDP1 infrastructure, providing sufficient information to enable a robust evaluation to be made of the potential environmental consequences of the proposed decommissioning activities.

The VDP1 and LDP1 infrastructure is located in a marine environment that is typical of this part of the southern North Sea. ConocoPhillips has considered that there are potentially certain times of the year when populations of seabirds, life stages of fish, marine mammal presence and commercial fishing interests may be more susceptible to potential impact. However, the area is not considered particularly sensitive to the proposed decommissioning activities (Section 4).

All of the infrastructure covered under the VDP1 and LDP1 programmes is situated within the North Norfolk Sandbanks and Saturn Reef SCI, which is designated for the Annex I habitats:

- Sandbanks – that are slightly covered by seawater all the time; and
- Biogenic reefs – formed by the polychaete worm *Sabellaria spinulosa*.

ConocoPhillips have demonstrated that there will be negligible impact to the SCI from the proposed decommissioning activities or from the long-term presence of the structures decommissioned *in situ* (Section 9).

The Annex II species recorded within and around the VDP1 and LDP1 infrastructure include harbour porpoise, common seal and grey seal. Harbour porpoise are most abundant in March, August and September (UKDMAP, 1998; Reid *et al*., 2003; Section 4). Grey and common seals are present throughout the year however only in low numbers, 0–5 and 0–10 individuals, respectively (Jones *et al*., 2013).

Following the identification of the interactions between the proposed decommissioning activities and the local environment, the assessment of all potentially significant environmental impacts, stakeholder consideration, the key environmental concerns identified as requiring consideration for impact assessment were:

- Effects of energy use and atmospheric emissions (Section 7).
- Effects of underwater noise generated during the decommissioning activities (Section 8).
- Effects of seabed disturbance during decommissioning activities – vessel anchoring, rock-placement, mattress removal, dredging etc. (Section 9).
- Habitat change within the SCI as a result of rock-placement material (Section 9).
- Sediment contamination originating from the degradation of pipelines decommissioned *in situ* (Section 9).
- Physical presence of vessels causing interference/ displacement of other users of the sea (Section 10).

- Socioeconomic impacts to fisheries from pipelines, mattresses and rock decommissioned *in situ* (Section 10).
- Potential snagging hazards posed by pipelines, rock-placement, and mattresses decommissioned *in situ* (Section 10).
- Potential release of residual contaminants during routine decommissioning activities (Section 11).
- Non-routine events – spillage of hydrocarbons or other fluids during the decommissioning activities or through accidental events such as vessel collisions (Section 12).

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

ConocoPhillips are aware that a number of oil and gas fields/ installations in the SNS 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 SNS will be increased in the short-term. Decommissioning activities may contribute to overall gaseous emissions in the SNS but the impact of this is estimated to be very minor in context with total UKCS emissions associated with the oil and gas industry. Noise impacts will also be increased during decommissioning, but will be transient and are not expected to have a cumulative impact.

Discharges to sea and activities impacting the seabed have the potential to affect the sandbanks and *S. spinulosa* reefs found in the North Norfolk Sandbanks and Saturn Reef SCI. Within the SCI there are a further 62 platforms, one buoy, 37 subsea structures and 121 subsea pipelines out-with the scope of the VDP1 and LDP1 facilities.

Decommissioning activities are likely to result in an overall impact on the SCI in the short-term. Decommissioning the majority of the subsea VDP1 and LDP1 infrastructure *in situ*, the long-term and cumulative impact of these activities will be limited.

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

Overall, the ES has evaluated the environmental risk reduction measures and although the intent is to decommission several pieces of infrastructure *in situ*, this document concludes that ConocoPhillips have, or intend to, put in place sufficient safeguards to mitigate the potential environmental risk and to monitor the implementation of these measures.

In addition, the ES has highlighted the positive impact that the decommissioning of the VDP1 and LDP1 infrastructure will have on commercial fisheries with the opening of areas of the sea which have previously been excluded for safety reasons, and which is far in excess of the small area of seabed which may be unavailable from the presence of mattresses and rock-placement decommissioned *in situ*.

Therefore it is the conclusion of this Environmental Statement that the recommended options presented for the decommissioning of the VDP1 and LDP1 infrastructure can be completed without causing significant adverse impact to the environment.

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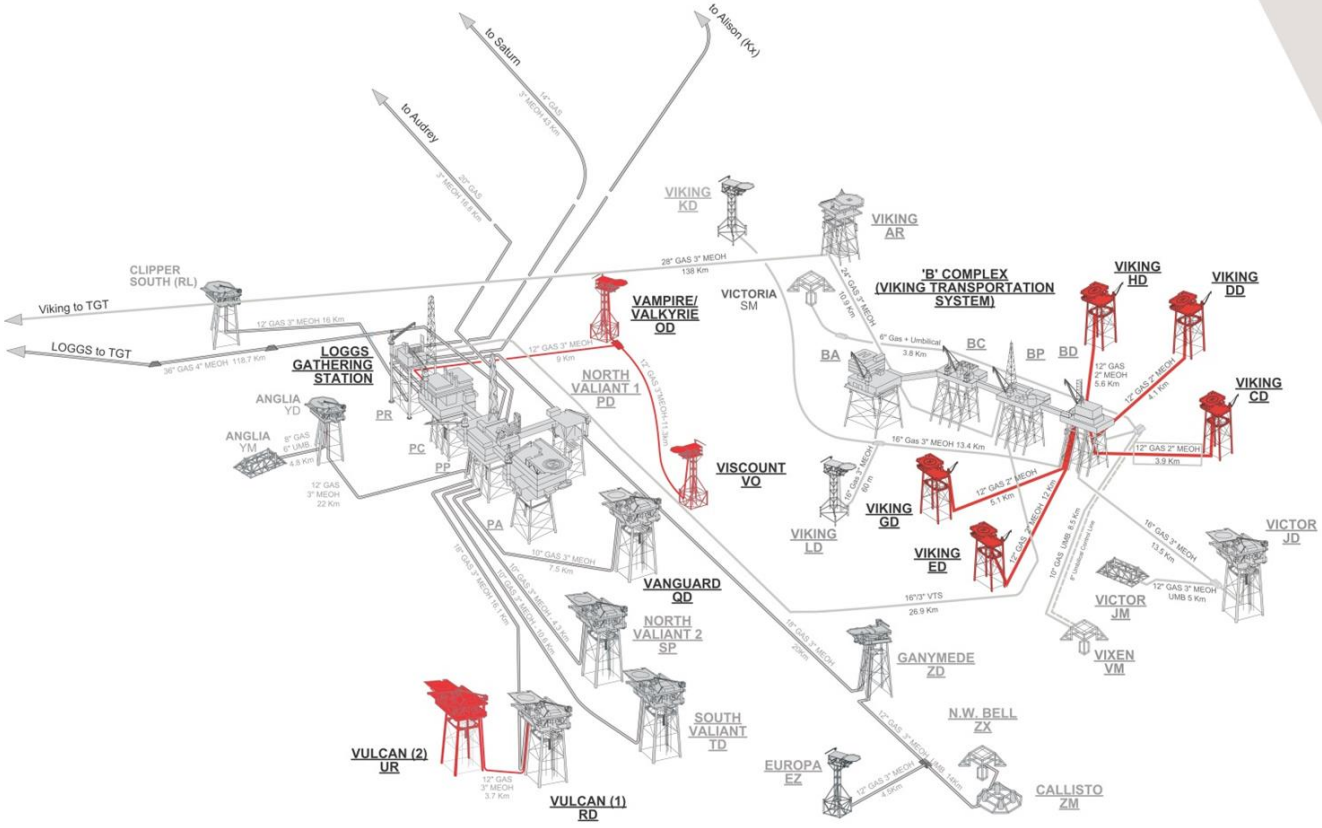
SNS PHASE 1 DECOMMISSIONING PROJECT

APPENDICES FOR THE SNS DECOMMISSIONING PROJECT ES: VIKING VDP1 AND LOGGS LDP1



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APPENDIX A

SUMMARY OF ENVIRONMENTAL LEGISLATION

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This appendix presents a summary of the key regulatory drivers applicable to the SNS Phase 1 Decommissioning Project as well as the policy, legal, and administrative framework within which this EIA was carried out.

Table A.1: Decommissioning

Regulatory Body	Legislation	Summary of Requirements
DECC	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.
DECC	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.
DECC	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 DECC for approval to disturb, recover or place items on the seabed can be made under the provisions of the MCAA using a Marine License.
DECC/ HSE	Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 Pipeline Safety Regulations 1996 Petroleum Act 1998	When decommissioning a field, operators should contact DECC 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.
EA	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 authorised 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.

Regulatory Body	Legislation	Summary of Requirements
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.
EA	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.
EA	Radioactive Substances Act 1993, Amendment (Scotland) Regulations 2011 and the Environmental Permitting (England and Wales) Regulations 2010	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.

Regulatory Body	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/ DECC	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/ DECC	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.
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

Regulatory Body	Legislation	Summary of Requirements
DECC	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 a 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 Pipe-lines (Assessment of Environmental Effects) Regulations 1999 (as amended 2007)	These Regulations implement the EIA Directive with regard to the offshore oil and gas industry. The Regulations require an EIA and the associated public consultation document (ES) to be submitted for certain projects. Although there is currently no statutory requirement to undertake an EIA at the decommissioning stage, a decommissioning programme will nevertheless need to be supported by an EIA. The ES submitted for the development under the EIA regulations requires the applicant to consider the long term impacts of the development and these include the impacts arising from decommissioning.
	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

Regulatory Body	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

Regulatory Body	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 resulting from flaring, burning of cuttings, muds, well clean-up emissions and well testing; • release of gases entrained in drilling fluids and cuttings; • emissions from treatment, handling and storage of reservoir hydrocarbons; and • emissions from diesel engines solely dedicated to the exploitation of seabed mineral resources.
DECC	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.
	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.

Regulatory Body	Legislation	Summary of Requirements
DECC	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 2009	The objective of the EU Regulation is to reduce the emissions of fluorinated greenhouse gases (F-gas) including hydrochlorofluorocarbons (HCFCs), perfluorocarbons and sulphur hexafluoride as covered by the Kyoto Protocol. EU Regulation 517/2014 came into force in 2014, applies in UK from 1 January 2015, and repealed EU Regulation 842/2006 to cut F-Gas emissions. These gases have been developed to replace ozone depleting substances such as chlorofluorocarbons and HCFCs but are long-lived powerful greenhouse gases. The Regulations include requirements on the leakage detection and labelling requirements of systems such as refrigeration systems, air-conditioning units and heat pumps that use these gases. Fluorinated gases are also used for firefighting offshore. The UK regulations detail the training and qualifications for those who work with F-Gas and provide powers for enforcement of the EU regulation.
	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 EU regulation is the primary regulation and details the compliance requirements in relation to the production, impact, export, placing on the market, recovery, recycling, reclamation and destruction of substances that deplete the ozone layer. The 2011 regulations give DECC the power to enforce the requirements of the EU regulation and the 2009 regulations detail the qualifications required by those working with Ozone depleting substances.

Table A.5: Access to Environmental Information and Public Participation

Regulatory Body	Legislation	Summary of Requirements
DECC	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

Regulatory Body	Legislation	Summary of Requirements
DECC	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.
DECC	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.

Table A.6 (continued): Conservation and Biodiversity

Regulatory Body	Legislation	Summary of Requirements
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.

Table A.7: Emergency Response

Regulatory Body	Legislation	Summary of Requirements
DECC	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) Regulations 1998 (as amended 2001)	The Merchant Shipping OPRC Regulations 1998 introduce into UK law the oil spill planning requirements and legal oil spill reporting requirements of the OPRC Convention. Every offshore installation and oil-handling facility must have an approved OPEP setting out arrangements for responding to incidents that cause or may cause marine pollution by oil, with a view to preventing such pollution or reducing or minimising its effect.

Table A.8: Environmental Liability

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

Table A.9: Chemicals, Drainage and Oily Discharge

Regulatory Body	Legislation	Summary of Requirements
DECC	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".

Regulatory Body	Legislation	Summary of Requirements
DECC/ 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/ DECC	The Merchant Shipping (Prevention of Oil Pollution) Regulations 1996 (as amended)	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.
MCA/ DECC	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: 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.

Regulatory Body	Legislation	Summary of Requirements
DECC	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.
DECC	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.
DECC	Offshore Pollution Liability Agreement 4th September 1974 (as amended)	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

Regulatory Body	Legislation	Summary of Requirements
EA	International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 Annex V, as amended	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.
EA	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.
EA	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.
EA	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).
EA	The Controlled Waste Regulations 1992 (as amended)	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.
EA	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).

Regulatory Body	Legislation	Summary of Requirements
EA	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.
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.

Table A.11: Naturally Occuring Radioactive Material (NORM) Contaminated Waste (sand, sludge and scale) and Radioactive Waste

Regulatory Body	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

Regulatory Body	Legislation	Summary of Requirements
DECC/ 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 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

Regulatory Body	Legislation	Summary of Requirements
DECC	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 DECC 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

Regulatory Body	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 nmiles from the nearest land and at least 200 metres deep.

Table A.15: Transboundary Impacts

Regulatory Body	Legislation	Summary of Requirements
DECC	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

Regulatory Body	Legislation	Summary of Requirements
DECC	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.
DECC	Continental Shelf Act 1964	This act extends the UK government's right to grant licences to explore and exploit the UKCS.
DECC	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
DECC	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

BASELINE ENVIRONMENTAL SURVEY TECHNICAL NOTE

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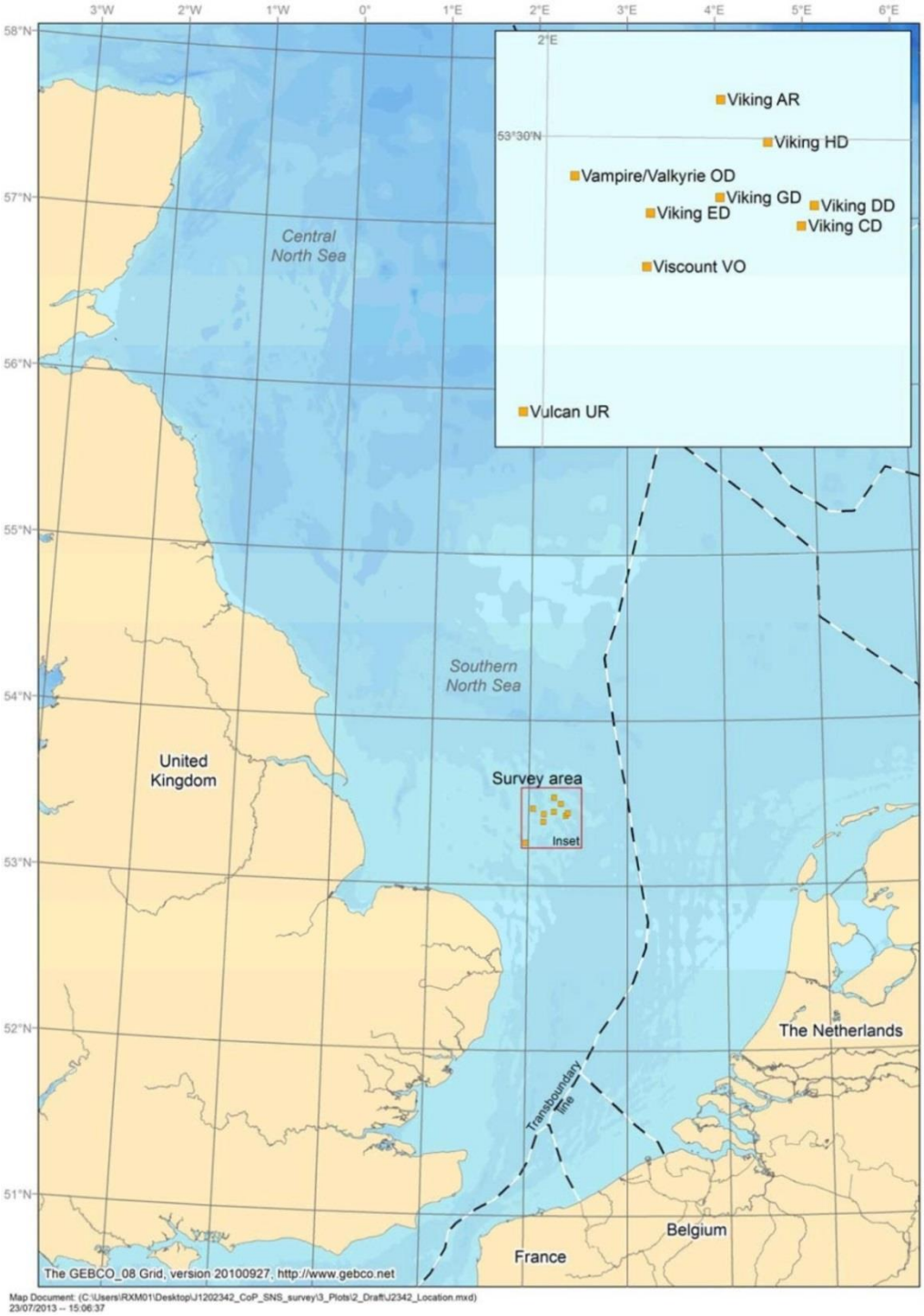
B.1 Introduction

This appendix summaries the pre-decommissioning environmental baseline survey reports and habitat assessment reports prepared by Fugro EMU Limited (Fugro) for ConocoPhillips U.K. Limited (ConocoPhillips) for the satellite platforms within the VDP1 and LDP1 fields under the Phase 1 decommissioning project in the southern North Sea (SNS) (Figure B.1).



Source: Fugro, 2014c.

Figure B.1: Field layout and platform locations in the Southern North Sea

The geophysical data presented in this appendix were collected for all five Viking field platforms covered in VDP1 (Viking GD, CD, DD, HD and ED) including additional sampling at Viking AR. Geotechnical data, including EBS analysis, were gathered for only two VDP1 platforms (Viking GD and CD), however similar sampling and analysis was undertaken at the Viking AR platform located 7.5 km NW of Viking HD This sampling intensity was considered representative for all Viking platforms due to their close proximity and similar sediment characteristics.

LOGGS filed platforms surveys presented in this appendix were sampled following similar regime. For Vulcan UR, Viscount VO and Vampire/ Valkyrie OD in the LOGGS field, covered in LDP1, geophysical data were collected, while geotechnical data, including EBS analysis, were gathered only for Vulcan UR and Vampire/ Valkyrie OD.

The EBS surveys are summarised in Table B.1. Each platform was subject to a 2 km by 2 km survey block centred on the platform. This was covered by swathe multi-beam and side scan sonar surveys. There were varying degrees of environmental baseline survey and sampling conducted at each of the platform locations.

Table B.1: EBS survey location and descriptions.

Area	Survey	Platform	Survey Date	Survey Type
VDP1	Fugro EMU Ltd 2014a and 2014c	Viking AR	May – June 2013	Analogue Survey – Sensitive Habitats, Full EBS* (11 Stations), sediment analysis.
		Viking GD	May – June 2013	Analogue survey, habitat assessment, limited EBS** (5 stations), sediment analysis
		Viking CD	May – June 2013	Analogue survey, habitat assessment, limited EBS** (5 stations), sediment analysis
LDP1	Fugro EMU Ltd 2014b and 2014d	Vulcan UR	May – June 2013	Analogue survey, habitat assessment, full EBS* (11 stations), sediment analysis
		Vampire/ Valkyrie OD	May – June 2013	Analogue survey, habitat assessment, limited EBS** (5 stations), sediment analysis

* Full EBS – Included analysis of physical, chemical and biological parameters from seabed grab samples. Full refers to an extended sampling pattern in a cruciform pattern aligned with the predominant current.

**Limited EBS – Limited environmental sampling pattern along a transect in the direction of the predominant current.

B.2 Pre-Decommissioning Survey Methodology and Results

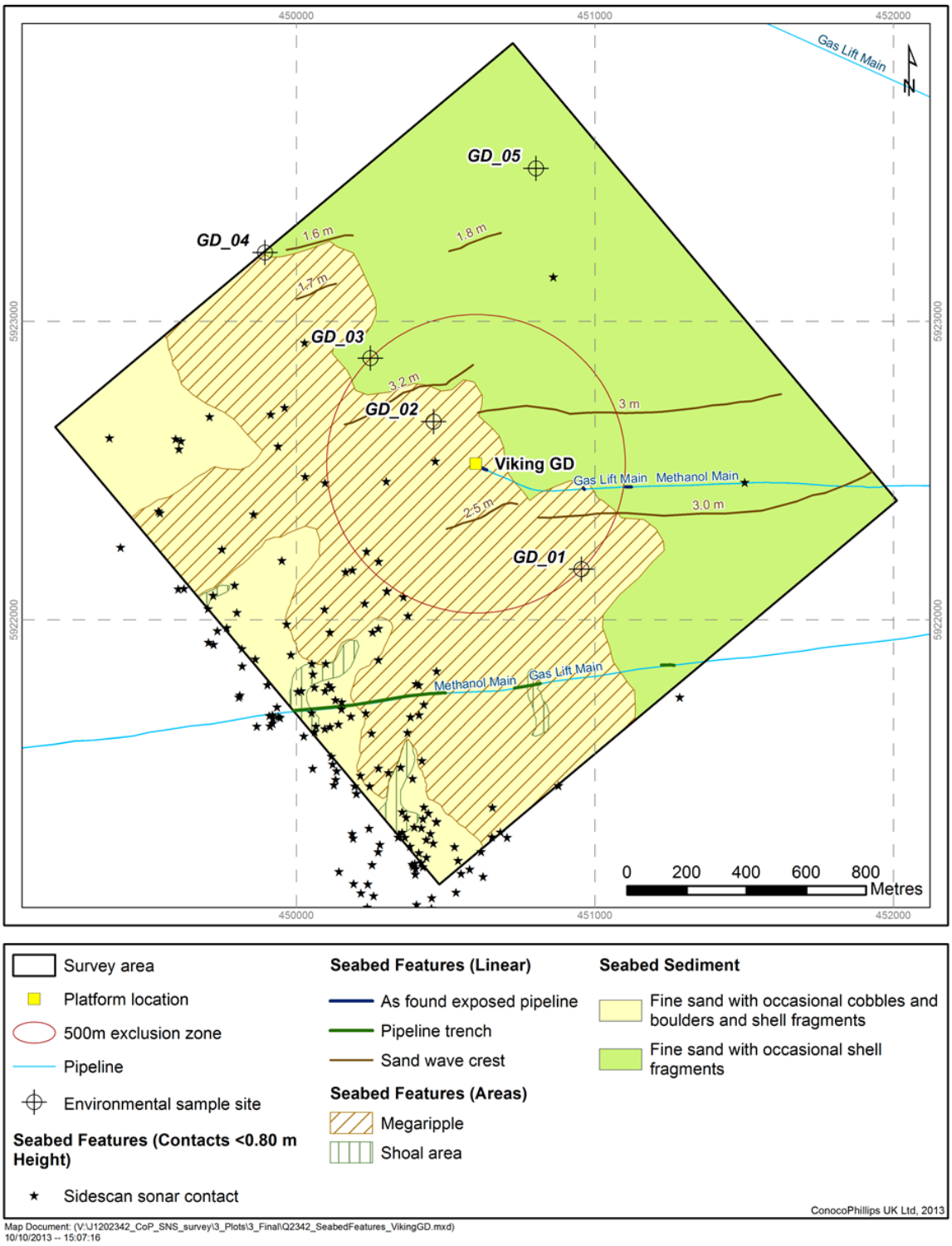
Fugro delivered two reports for each of the decommissioning areas (VDP1 and LDP1). One report described the remote habitat survey based on geophysical and video and still camera techniques; while the second report provided the results from the analysis of the seabed samples. In the following subsections the findings are presented from the habitat survey reports and the baseline data for the areas.

B.3 Habitat Survey Reports - Results

The habitat survey reports concentrated on the data from the analogue survey (multi-beam and side scan sonar). The analysis of the TV stills and video footage was reviewed by Fugro EMU marine biologists and each habitat type observed was given a EUNIS classification. In the absence of more detailed information from the EBS data, the

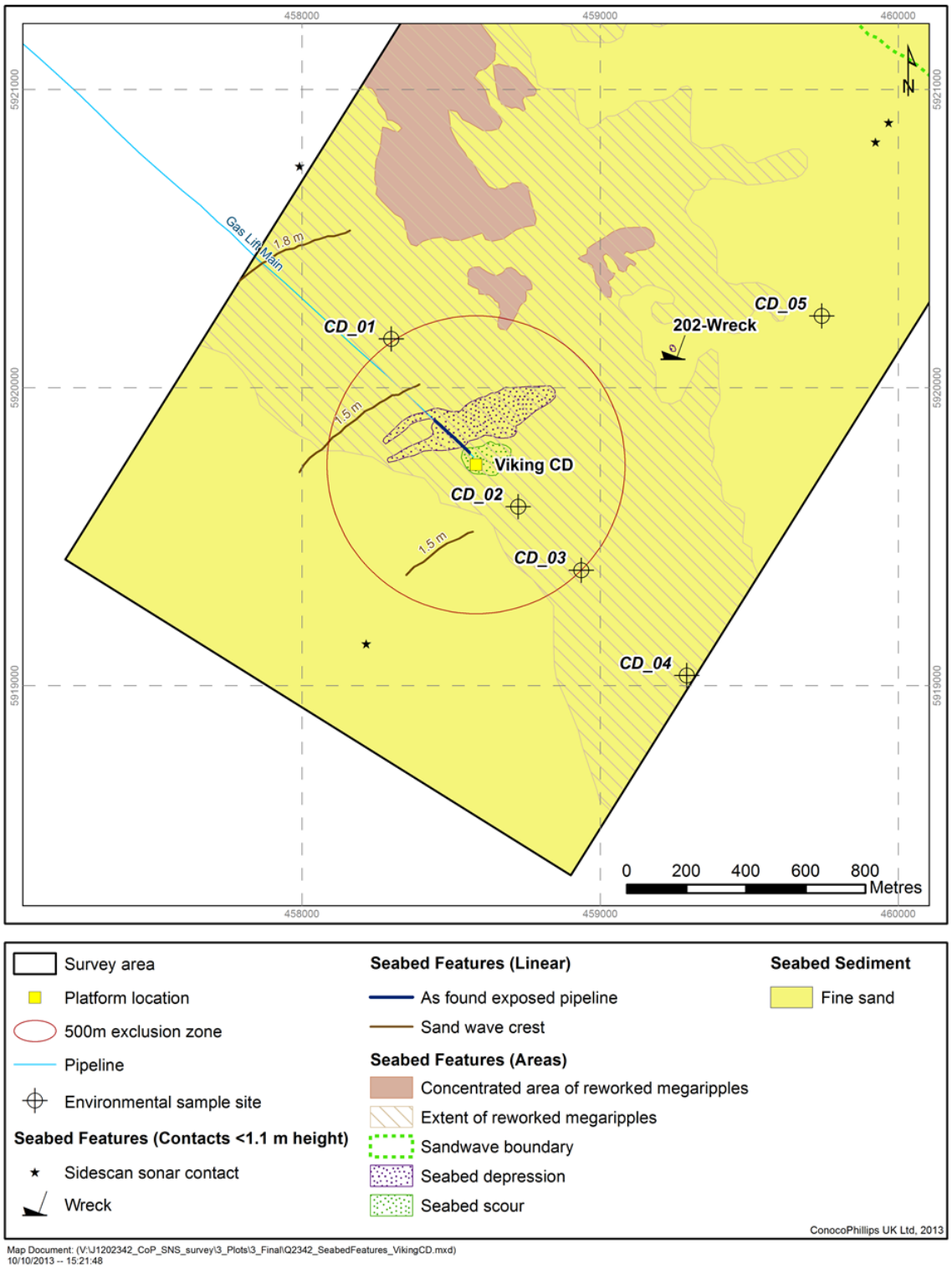
habitats were classified to EUNIS Level 3 (main habitats). Where there was additional information from the EBS a description of the macrofaunal data was provided.

Figures B.2 to B.10 summarise the interpreted seabed features, drop down TV stills and video transects.



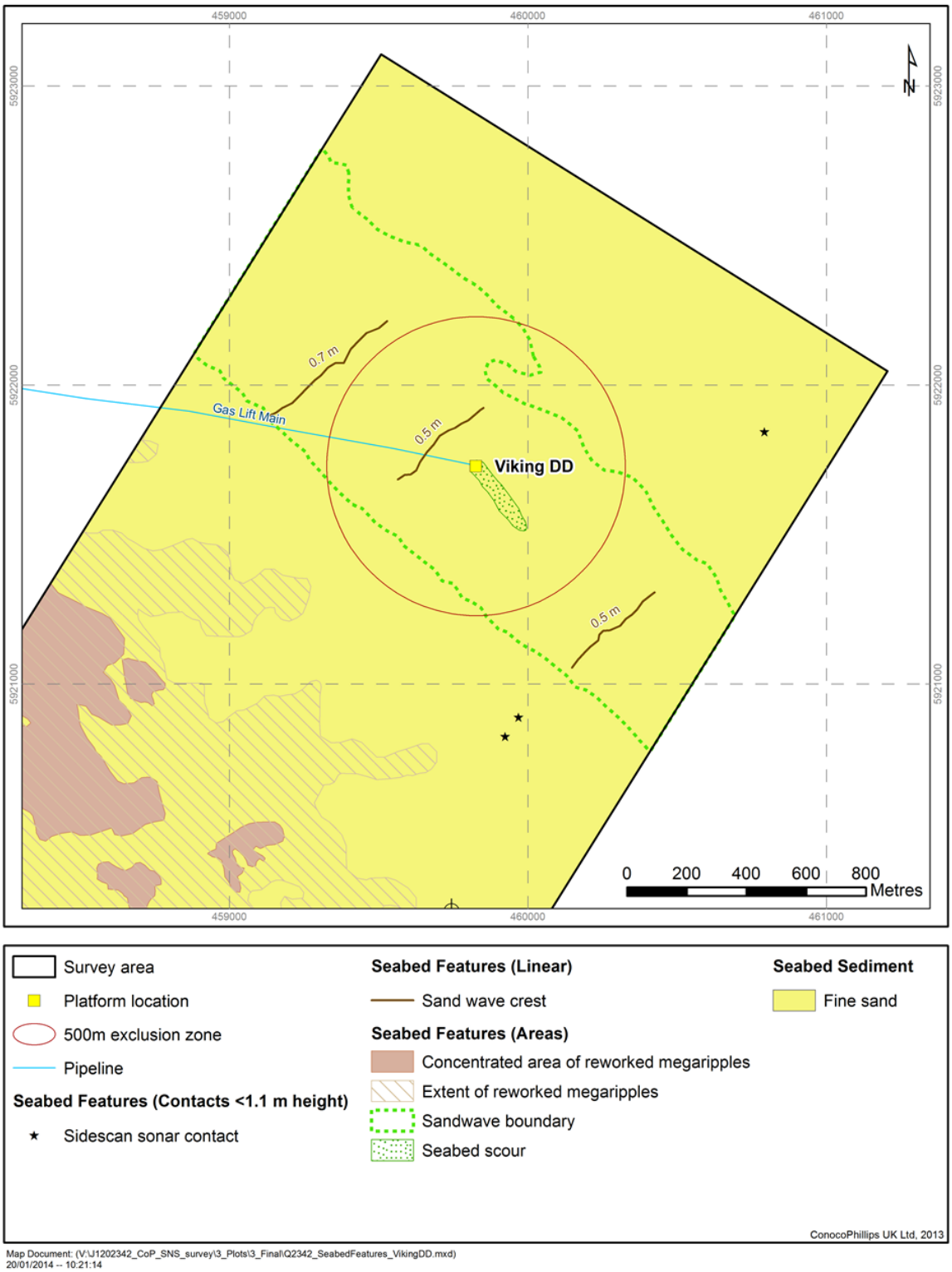
Source: Fugro, 2014a

Figure B.2: Interpreted seabed features showing environmental sampling locations at Viking GD



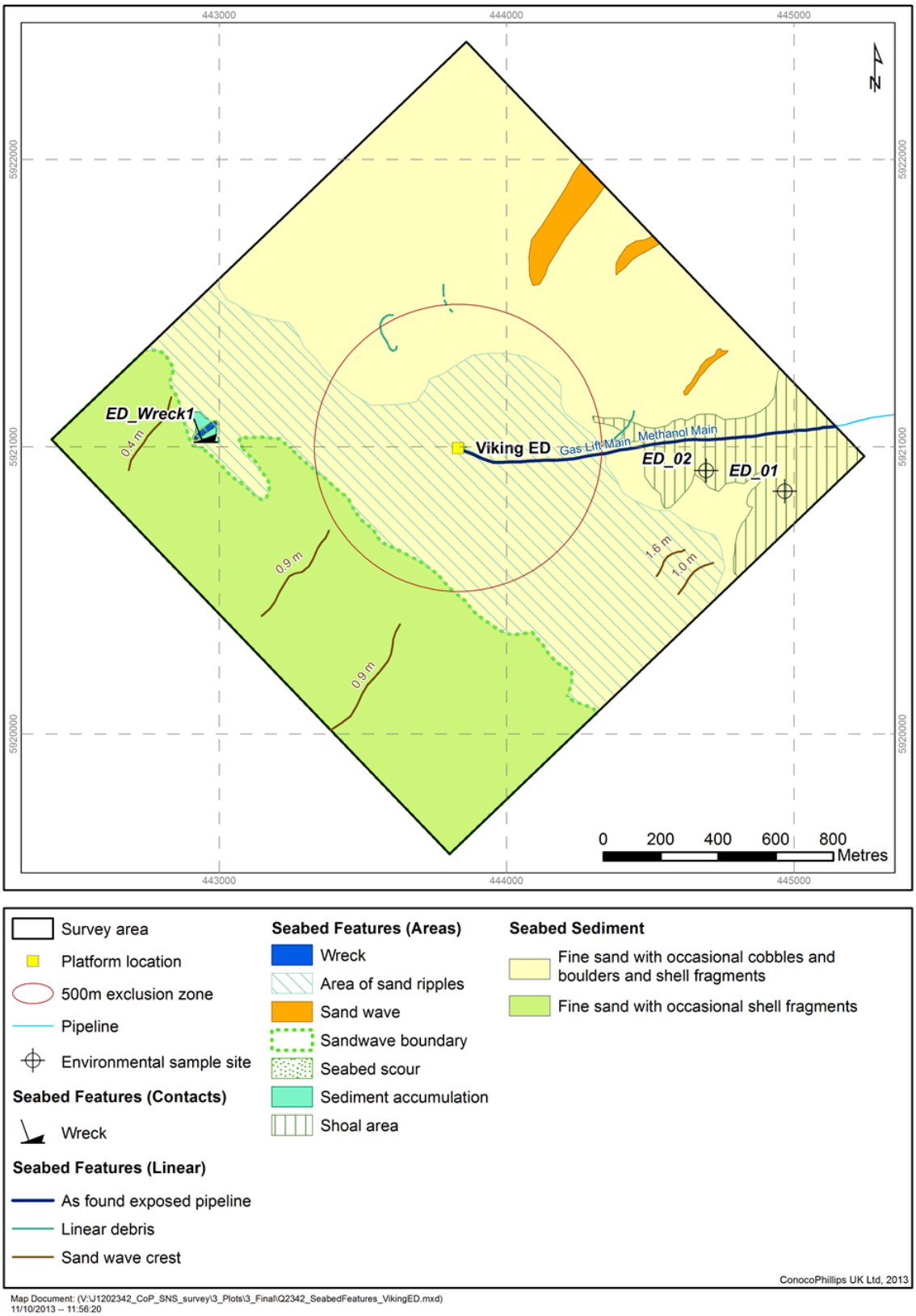
Source: Fugro, 2014a

Figure B.3: Interpreted seabed features showing environmental sampling locations at Viking CD



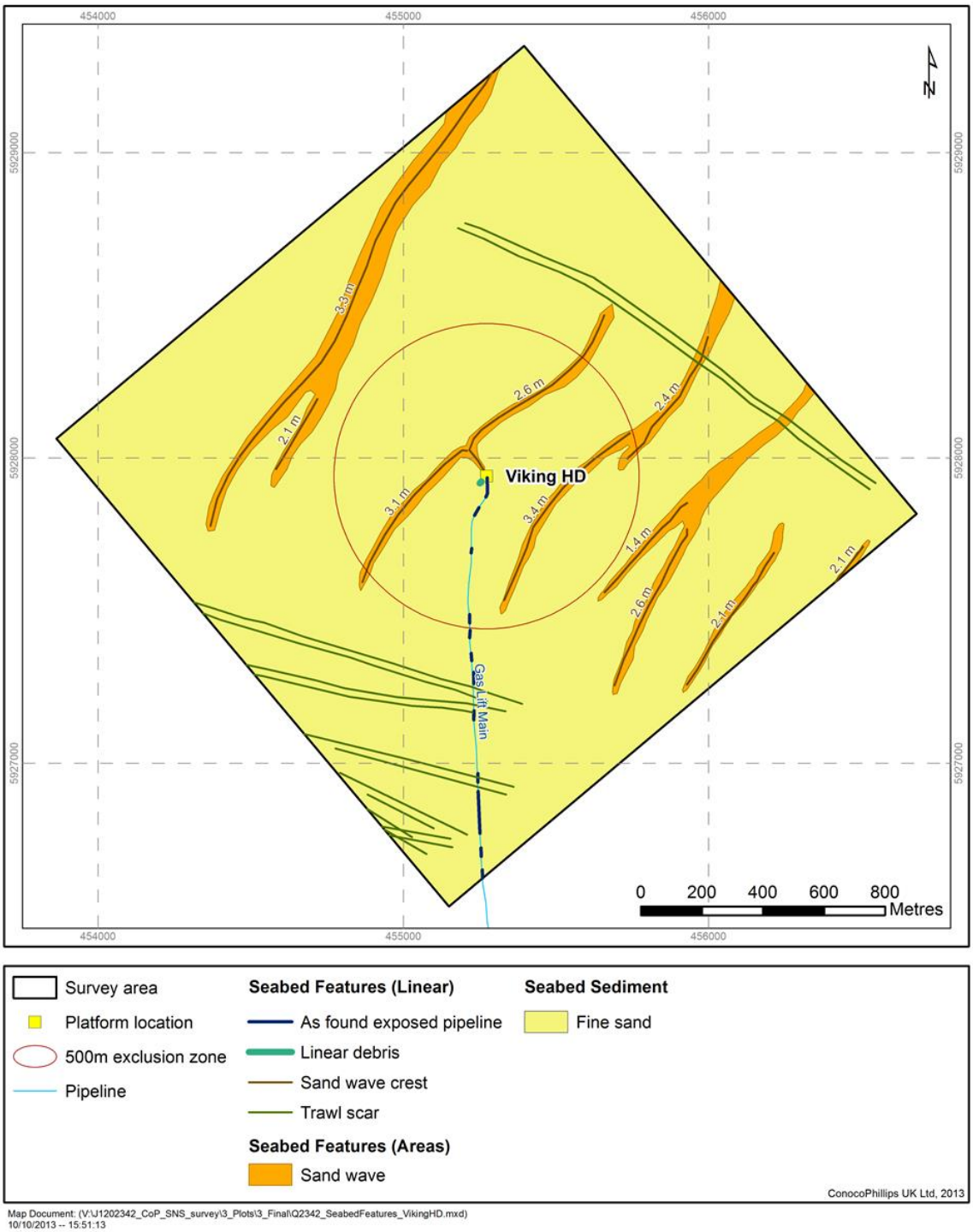
Source: Fugro, 2014a

Figure B.4: Interpreted seabed features at Viking DD



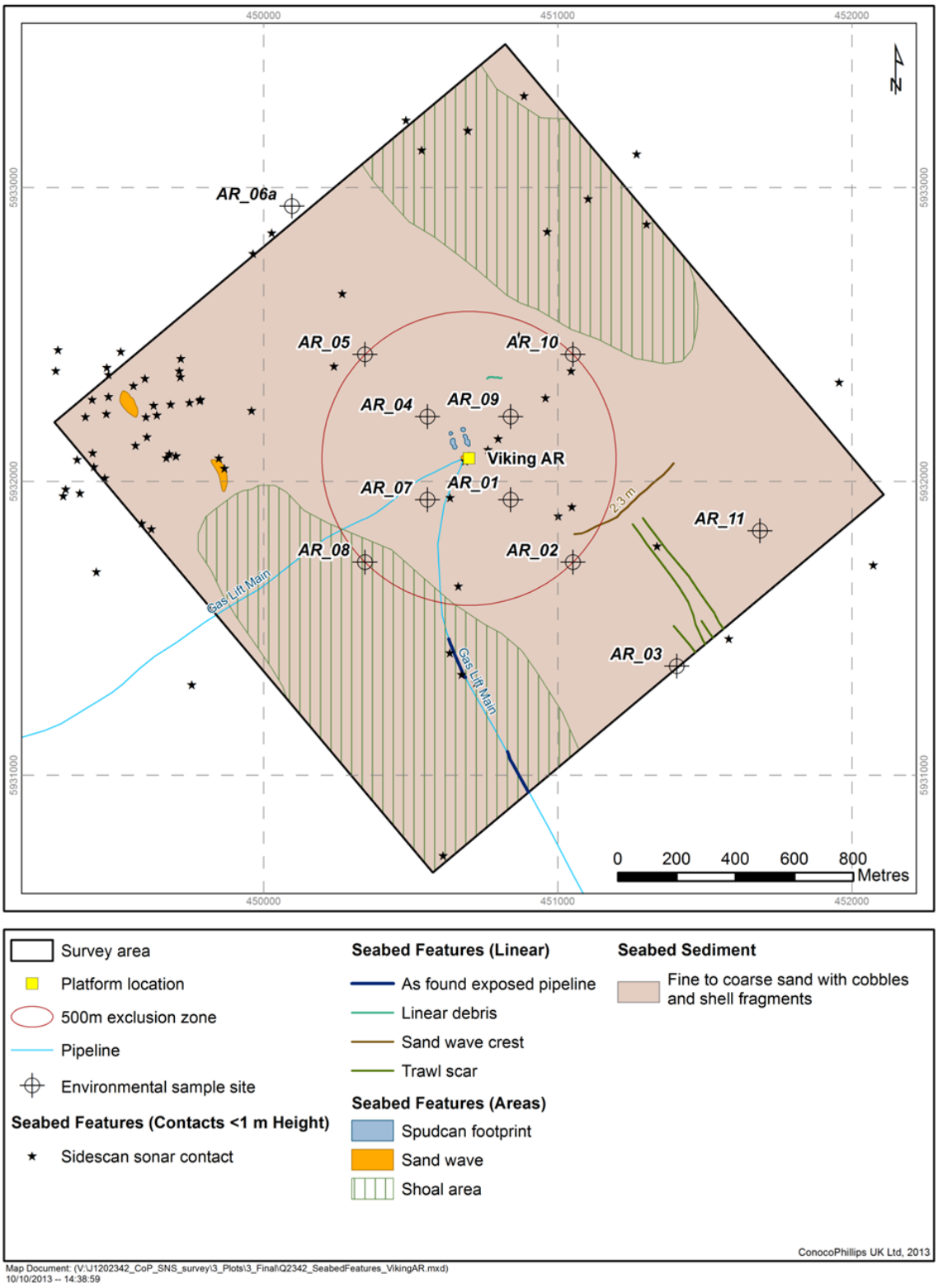
Source: Fugro, 2014a

Figure B.5: Interpreted seabed features showing habitat sampling locations at Viking ED



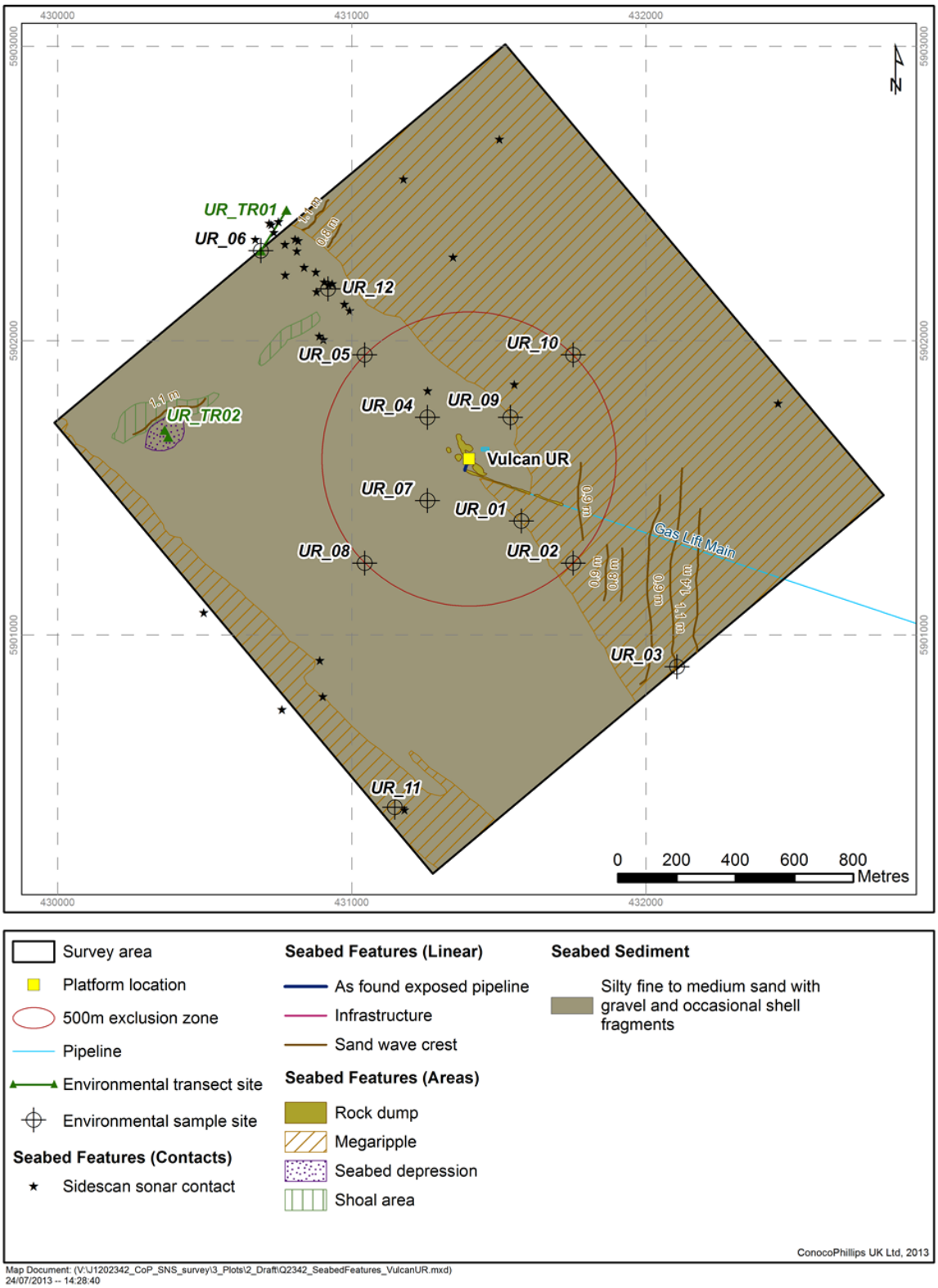
Source: Fugro, 2014a

Figure B.6: Interpreted seabed features at Viking HD



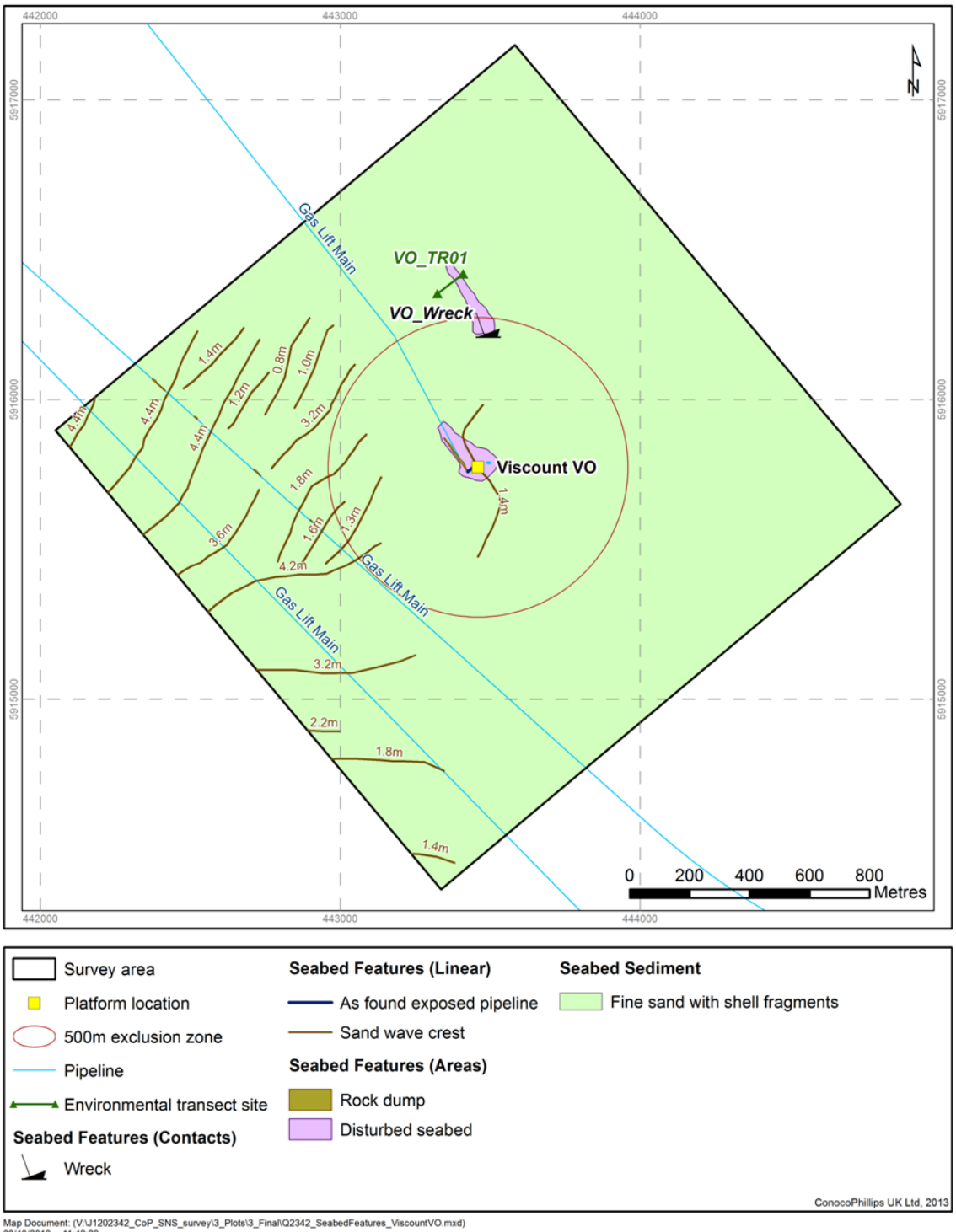
Source: Fugro, 2014a

Figure B.7: Interpreted seabed features at Viking AR



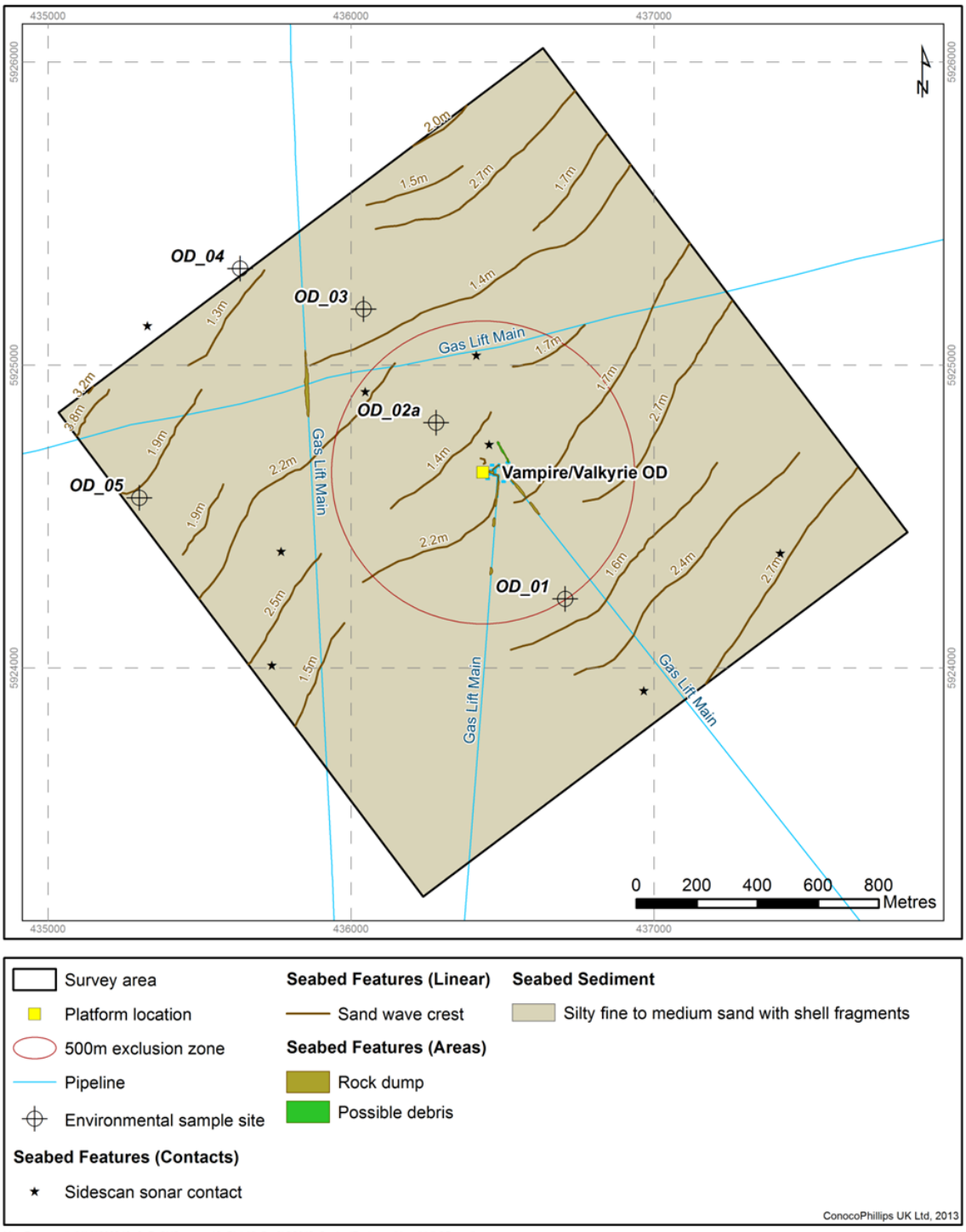
Source: Fugro, 2014b

Figure B.8: Interpreted seabed features showing environmental sampling locations at Vulcan UR



Source: Fugro, 2014b

Figure B.9: Interpreted seabed features at Viscount VO



Map Document: (V:\J1202342_CoP_SNS_survey\3_Plots\2_Draft\Q2342_SeabedFeatures_VampValkOD.mxd)
29/07/2013 -- 15:21:36

Source: Fugro, 2014b

Figure B.10: Interpreted seabed features showing environmental sampling locations at Vampire/ Valkyrie OD

B.4 Decommissioning Environmental Reports - Results

Environmental baseline data were collected in both the VDP1 and LDP1 areas (Table B.1). A seabed sampling programme was undertaken using a Dual van Veen grab at four of the platforms (two in each DP area). There were 17 successful grabs in the VDP1 area and 16 successful grabs in the LDP1 area. The physico-chemical and macrofaunal characteristics of these samples were then analysed. Surface sediment samples were

analysed for particle size, organic matter, hydrocarbons and heavy metal content. Sediments from stations located on the prevailing current (200 m from the platforms) were also analysed for tributyltin. Macrofaunal analysis (on 0.5 mm fraction) was carried out on duplicate samples with a further replicate stored for possible future analysis should there have been marked variation between the duplicate samples. On the basis of these results, no additional replicate samples were analysed. Figures B.11 and B.12 summarise the station locations for the physico-chemical and biological sampling programme.

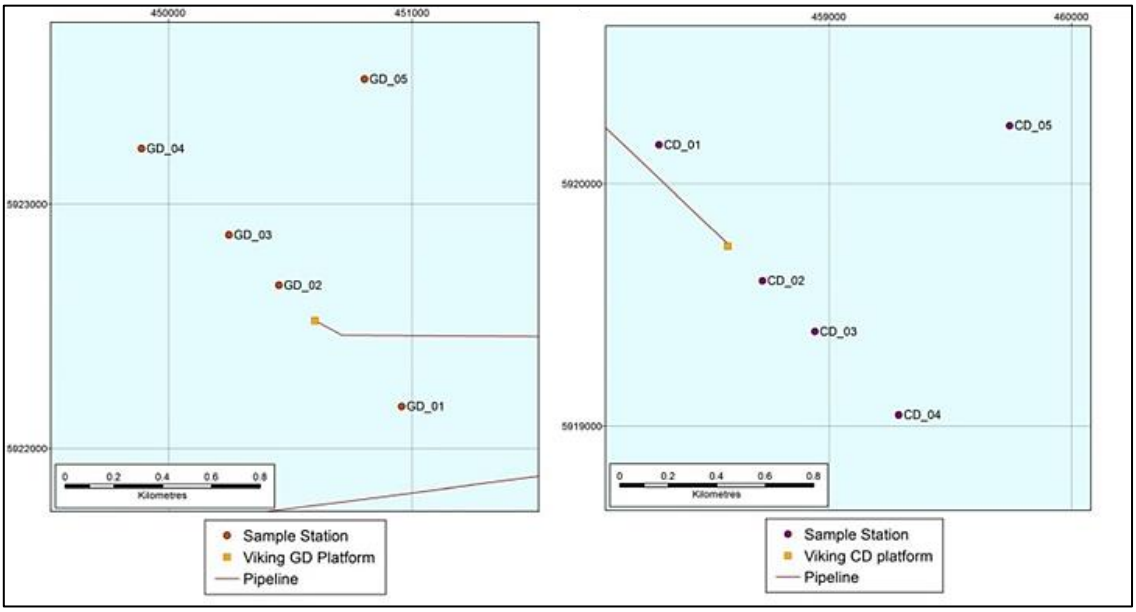


Figure B.11: VDP1 area EBS station locations

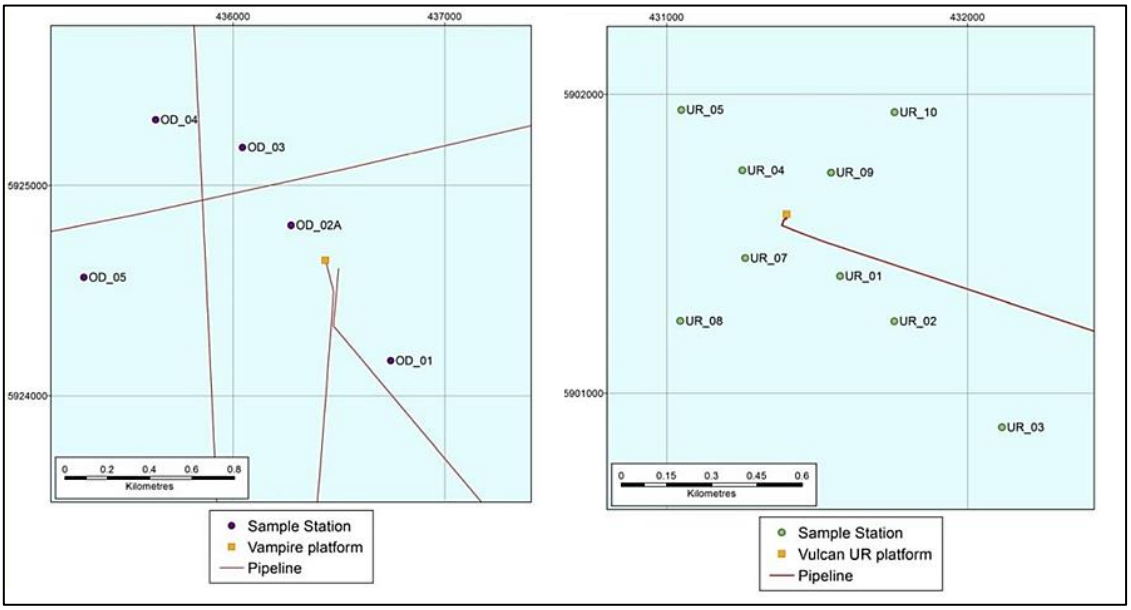


Figure B.12: LDP1 area EBS station locations

A comparison of the analytical data and available references for the survey areas was also undertaken. In addition, statistical correlations were calculated for the chemical and biological elements analysed. The statistical analysis techniques were the Kendall rank

correlation coefficient, multi-dimensional scaling and the Spearman's rank correlation coefficient using the BIOENV algorithm in the PRIMER BEST routine.

B.5 VDP1 Area –Viking CD and Viking GD Sample Stations

There were no significant differences in multi-dimensional scaling analyses between the stations at both the Viking CD or Viking GD platforms.

Overall the silt/clay and organic content levels at Viking CD and Viking GD were far below what would be expected if drill cuttings were present at these platform locations.

There were no significant correlations between the Viking CD and GD sediment characteristics and the other environmental or benthic variables.

In general the hydrocarbon content was within background levels across the sites sampled. However, there were traces of kerosene-like enhanced mineral oil-based fluids/low toxicity oil-based fluids (EMOBF/LTOBF) at station GD_02.

Total organotin (mono-, di-, tributyltin) levels for all the VDP1 samples analysed were below detectable level of <0.4 ngg^{-1}.

A few weak positive correlations exist between THC and selected metals for Viking CD; however, no correlations were found for THC at Viking GD.

There was a high degree of variability in the levels of metals at the Viking GD stations with the Viking CD stations showing a much lower level of variation between stations in this area. Comparisons with data from OSPAR and UKOOA have shown that although, when normalised, the lead and cadmium levels were above their relevant assessment criteria (Background Concentration and Effects Range - Low) these were of no obvious environmental concern and could generally be ascribed as within background concentrations consistent for the region of the southern North Sea.

Metal concentrations at Viking GD may have been attributed to possible drilling related discharges however evidence of a discernible cuttings pile were not evident due to the dynamic nature of the site, there is also the possibility that the background levels are naturally higher in this area due to the presences of fine-grained sediments which are known to be preferential for the accumulation of trace metals (OSPAR, 2000). A few weak, positive correlations were noted between selected metals for the Viking CD and GD stations.

Both platform locations exhibited a typical southern North Sea benthic community associated with sandy mobile sediments. Epifauna were sparse across GD with no epifauna observed at Viking CD. Multivariate analysis showed small scale spatial variability between stations across each location but no significant differences between communities. This indicated that there was no evident effect from the drilling activities on the benthic communities around the three platform stations.

Due to the water depth and location of Viking GD and CD close to the Indefatigables Sandbank and the results from the habitat sampling it is likely this is consistent with an Annex I sandbank habitat and that they are connected to this network of sandbank habitats.

The surveys identified a series of small patches of *Sabellaria spinulosa* on an otherwise fine sand environment to the west of the Viking ED platform (station ED_01), however these aggregations were limited and did not elevate above the seabed surface.

Consequently, they did not constitute a *S. spinulosa* reef as defined by JNCC (Gubbay, 2007).

B.6 LDP1 Area– Vulcan UR and Vampire Valkyrie OD Sample Stations

The THC for both, the Vulcan UR and Vampire/ Valkyrie OD was similar to background levels expected for the southern North Sea. However, there was a weak, positive correlation between THC and barium and tin for the Vulcan UR area. This would suggest that traces of drill cuttings are present around the platform. There were no correlations found for THC at the Vampire/ Valkyrie OD site. Detailed results can be found in Table B.2.

The organotin (mono-, di-, tributyltin) levels were below detectable levels in all but one station across the two platform locations in the LDP1 area. At station UR_01 the tributyltin level was 0.7 ngg^{-1}, however this was lower than the provisional upper environmental assessment criteria (EAC) limit suggested by OSPAR regulations and as a result is of little environmental concern.

Concentrations of lead and cadmium were above their BC and Effects Range – Low (ERL) levels when normalised for aluminium. This may be associated with the natural conditions in the southern North Sea or natural sea bed formations such as fine-grained sediments which are known to be preferential for the accumulation of trace metals (OSPAR, 2000).

Metal concentrations in both, the Vulcan UR and Vampire/ Valkyrie OD were generally similar or slightly lower, with the exception of chromium which was slightly higher, than those previously observed. Generally metal concentrations at the two sites were thought to be of no obvious environmental concern and were within the range of natural background concentrations for this region of the southern North Sea (Fugro, 2014d). Detailed results can be found in Table B.2.

There were no significant correlations observed for sediment silt/ clay content. A weak correlation for the full environmental variables against the community structure was identified at Vulcan UR and indicated that mean diameter, silt/clay and the metals Al, Cu and Pb were the main environmental variables influencing the benthic communities present. Detailed results can be found in Table B.2.

Macrobenthic communities present at the sampling sites in DP area 2 were typical of those found in the southern North Sea. There was some evidence of Annex I habitats (sandbank habitat) present at the Vampire/ Valkyrie survey area; however these are likely to be edges of sandbanks due to the depth at the site being in excess of 20 m. Four areas were identified (three at Vulcan UR and one at Viscount VO) as potentially being *Sabellaria spinulosa* reef however on ground-truthing the sites all areas at Vulcan were discounted and the area at Viscount was found to only have flattened aggregations and not habitat that would be classed as reef.

Table B.2: Detailed results of the environmental sampling chemical results for sites in VDP1 and LDP1 areas

Reference	THC	As	Cr	Ni	Cu	Zn	Cd	Hg	Ba	Pb
North Sea Reference Values (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)	21.28 (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	0.05	-	-
Effects Range – Low (ERL)	-	-	81	-	34	150	1.20	0.15	-	47
VDP1Sample Data Range (µgg^{-1} dry weight)										
Viking CD	0.5 - 2.0	11.3 - 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	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
LDP1 Sample Data Range (µgg^{-1} dry weight)										
Vulcan UR	1.2 - 5.6	5.46 - 25.5	3.73 - 9.26	2.08 - 4.31	0.60 - 11.2	7.05 - 55.7*	0.01 - 0.02	<0.02	5 - 264	2.49 - 6.45
Vampire/ Valkyrie OD	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
Note: *OSPAR (2005) - maximum expected background concentration (BC), normalized to 5% aluminium if the environment were pristine; (–) means no data currently available and UKOOA (2001) - values are mean (95th percentile in brackets).										

B.7 Comparison with Historic Survey Work

Physical and environmental characteristics were compared with historic surveys and cited background data reports. These included quality status reports by North Sea Task Force (NSTF, 1993), the OSPAR Agreement on background concentrations (OSPAR) and the OSPAR Quality Status Reports (OSPAR 2000 and 2010). The United Kingdom Offshore Operators Association (UKOOA) compiled environmental data around oil and gas installations between 1975 and 1995 (UKOOA, 2001).

There was a varying degree of compatibility of the data due to data collection techniques and presentation within reports. However they did give a qualitative indication of the historic environment. In most cases this indicated that the current environment was similar (benthic communities) or lower in terms of chemical disturbance (metals, hydrocarbons) than historic levels.

In addition to the references that were presented in the survey reports, publically available data was reviewed from ES and survey reports relating to locations in the vicinity of the proposed decommissioning works. These reports ranged from 1998 to 2008 and covered works in the Viking, LOGGS, Amanda and Agatha Fields:

- Conoco (U.K.) Ltd, 1998. ES for Proposed JX Development in Block 49/16 in the southern North Sea. DECC Ref: D/104/1998.
- Conoco (U.K.) Ltd, 2002. Environmental Statement for the Viscount development in Block 49/16. DECC Ref: D/1439/2001.
- ConocoPhillips (U.K.) Ltd, 2005. Mimas and Tethys Developments UKCS 48/9, 48/10 and 49/11, Environmental Baseline Report. Gardline Environmental Ltd Ref: Gardline Ref 6436-8.
- Venture Production (North Sea Developments) Ltd, 2006. Agatha Prospect Exploration, Amanda Field Appraisal, and Proposals for their Development. Environmental Statement. DECC Ref: D/3035/2006.
- ConocoPhillips (U.K.) Ltd, 2008. The installation of a 16”/3” Piggyback Pipeline between Viking BP and LOGGS PR Platforms. Environmental Statement. DECC reference: D/4023/2008.

Two of these reports cover locations in close proximity of the proposed works:

- The Viking replacement pipeline, between Viking BP and LOGGS PR platform (ConocoPhillips, 2008) and
- The Valkyrie development well from the existing Vampire platform (ConocoPhillips, 2003).

The sediment and environmental characteristics described in these reports are similar to those presented in the Fugro reports. Sediments range from poorly to well sorted sediments of fine to slightly gravely sand with particle size distributions typical of the region. Similarly, low numbers of taxa were observed but with varying degrees in numbers of individuals and densities, reflecting small demographic variability.

Sabellaria spinulosa were identified in several of the ES and survey reports mentioned above, with dense patches present in the Agatha, Amanda and Viking historic reports (Venture, 2006; ConocoPhillips, 2003; ConocoPhillips, 2008). There was evidence in the Fugro reports of *S. spinulosa,* across the region, however this was fragmented.

B.8 Conclusions

Although not all platforms within the VDP1 and LDP1 areas were surveyed, it is evident that the conditions described in the Fugro survey reports is consistent with the wider area. Overall, the environmental data obtained could generally be described as 'representative' of the southern North Sea area.

The scope of work for the sampling programme ensured coverage of all the sediment types present across the platform sites to be decommissioned under VDP1 and LDP1. The combination of the recent geophysical survey work, sediment sampling and habitat mapping has allowed an assessment of the environmental conditions likely to be present at these sites and across the wider DP areas. The habitats that were identified from these surveys and subsequent analysis were consistent with the range of habitats predicted by JNCC for the wider area (JNCC, 2011).

Sediments across all locations can be generally described as a sub-biotope of the EUNIS Level 5 biotope A5.252: *Abra prismatica*, *Bathyporeia elegans* and polychaetes in Circalittoral Fine Sand and A5.26: Circalittoral Muddy Sand with Viking CD only exhibiting characteristics of sub-biotope A5.252. Some habitats sampled at Vampire/ Valkyrie, Viking CD and GD are consistent with Annex I sandbank habitats, although due to the depths (>20 m) present these would be more consistent with the edges of sandbank features rather than the summits. Small areas of *S. spinulosa* were observed but due to their patchy nature and lack of elevation from the seabed these would not be classified as qualifying reef habitat. However these patches may form reef habitat if suitable environmental conditions are maintained for long enough periods for reefs to develop.

The Vampire/ Valkyrie OD habitat maps show features in the vicinity of sections of the interfiled pipelines which indicate seabed movement across the platform sites. This highlights the potential for sections of the pipeline to become exposed due to seabed conditions. ConocoPhillips have commissioned a pipeline burial and stability study to present an overview of the changing pipeline exposure.

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APPENDIX C

NON-SIGNIFICANT IMPACTS

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This Appendix provides the justification for the environmental risks that were considered to be “low” during the Environmental Risk Assessment (Section 6) and were excluded from further investigation within the main Environmental Statement.

Table C.1: Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
General decommissioning activities: Planned operations			
Physical presence of vessels.	• Commercial fishing. • Shipping. • Government, MOD. • Other commercial users. • Recreation and amenity users. • Onshore communities (Resources).	• Project planning. • Design and operational procedures. • Notice to mariners and consultation with NFFO. • 500 m safety zones where appropriate. • Navigation aids. • Communications. • Good seamanship. • Consent to locate for vessels.	• Shipping/ fishing traffic can readily navigate round the vessel spread at any given stage during the work programme.
Operational discharges of treated oily bilge.	• Water quality. • Water column (plankton). • Finfish and shellfish. • Seabirds.	• Separation systems for oil recovery from bilge. • Discharges of oil bilge to marine environment will be within permitted levels of 15 ppm.	• Any discharge will be within permitted limits.
Waste produced from onsite vessels.	• Air quality (local). • Terrestrial flora & fauna. • Onshore communities (Resources).	• Materials will be reused or recycled where possible thereby minimising landfill requirements. • Compliance with UK waste legislation and duty of care. • Use of designated licensed sites only. • Permits and traceable chain of custody for waste management, shipment, treatment and onshore disposal.	• Storage and removal arrangements on the vessels will ensure minimal impact to environment. • Small-scale use of landfill capacity for non-reusable and non-recyclable wastes.

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
General decommissioning activities: Planned operations			
Sewage and grey water discharges.	• Water quality. • Water column (plankton). • Finfish and shellfish.	• Sewage and grey water will be screened as minimum requirement prior to disposal at sea, or contained and shipped to shore. • Vessels will be audited to ensure compliance.	• Sewage (organic material only) will be broken down and readily dispersed in the offshore environment. • This will result in a localised transient impact with the discharge dissipating to background concentrations within relatively short distance.
Macerated food waste discharge.	• Water quality. • Water column (plankton). • Finfish and shellfish.	• Food waste will be macerated prior to discharge; this will aid its dispersal and decomposition in the water column.	• Macerated food waste (organic material only) will be broken down and readily dispersed in the offshore environment. • The particles of food waste will be <25 mm in diameter, and will be rapidly and widely dispersed in the water column.
Ballast water uptake and discharge from the vessels on site.	• Sediment biology (benthos). • Water column (plankton). • Finfish and shellfish. • Ecosystem integrity.	• Adherence to the International Convention for the Control and Management of Ships' Ballast Water and Sediments.	• ConocoPhillips' 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
General decommissioning activities: Unplanned operations			
Dropped objects.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Commercial fishing. • Other commercial users.	• Adhere to lifting and handling procedures and use of certified equipment for lifting. • Retrieve major items of oil and gas related debris from the seabed after operations, in compliance with relevant legislation. • Undertake a debris/ sweep survey after completion of operations.	• Major items will be recovered from the seabed, therefore no long term impact would be anticipated. • Loss of individual hand-tools and other minor items of equipment will not constitute a threat to species, habitats or fishing.

Table C.2: Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Full removal of topsides and jackets: Planned operations			
Topside preparation for removal using hot cut, welding, etc.	• Commercial fishing. • Shipping. • Government, institution users (e.g. MOD). • Other commercial users. • Recreation and amenity users. • Onshore communities (Resources).	• Workpacks and procedures for topsides preparatory works. • Containment procedures.	• Activities within established 500 m exclusion zone. • All impacts will be temporary not permanent.
Engineering down and cleaning.	• Finfish and shellfish. • Sea mammals. • Seabirds. • Conservation sites.	• All new chemicals will be risk-assessed and covered by the relevant discharge permit under the Offshore Chemical Regulations 2002. Chemicals within the topsides system will be covered within the relevant discharge permit at the time of decommissioning.	• Any discharge will be within permitted limits.
Power generation for underwater cutting of jackets legs.	• Water quality. • Air quality (local). • Water column (plankton). • Finfish and shellfish.	• Planned efficient cutting regime to achieve as few cuts as possible. • Emissions will be minimised through the use of well-maintained equipment. • Workpacks and procedures for cutting preparatory works, under which any hazardous materials will be identified and contained. • Containment procedures.	• The emissions will be a small-scale contributor of GHGs and other global gases. • Localised transient impact in the vicinity of the exhausts. • The atmospheric emissions will disperse in the exposed offshore environment.
Power generation for topside separation and cutting (plasma, flame or cold cutting).	• Air quality (local).	• Planned efficient cutting regime to achieve as few cuts as possible. • Emissions will be minimised through the use of well-maintained equipment. • Workpacks and procedures for topsides preparatory works, under which any hazardous materials will be identified and contained. • Containment procedures.	• The emissions will be a small-scale contributor of GHGs and other global gases. • Localised transient impact in the vicinity of the exhausts. • The atmospheric emissions will disperse in the exposed offshore environment.

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Full removal of topsides and jackets: Planned operations			
Topside separation and cutting (plasma, flame or cold cutting).	• Water quality. • Air quality (local). • Water column (plankton). • Finfish and shellfish.	• Planned efficient cutting regime to achieve as few cuts as possible. • Emissions will be minimised through the use of well-maintained equipment.	• The emissions will be a small-scale contributor of GHGs and other global gases. • The atmospheric emissions will disperse in the exposed offshore environment.
Power generation for dismantling structures onshore.	• Air quality (local).	• Emissions will be minimised through the planning of material movements and decommissioning contractors will be audited to ensure adequate maintenance of equipment.	• The emissions will be a small-scale contributor of GHGs and other global gases.
Dismantling structures/ recovery of materials onshore.	• Air quality (local). • Land. • Freshwater. • Onshore communities (Resources).	• ConocoPhillips will have in place the following industry standard controls: Materials will be reused or recycled where possible thereby minimising landfill requirements. Compliance with UK waste legislation and duty of care and compliance with receiving countries waste legislation if located out with the UK. Use of designated licensed sites only. Permits and traceable chain of custody for waste management, shipment, treatment and onshore disposal.	• Any cleaning required will be undertaken by a specialist contractor. • Potential for NORM/ additional chemicals to be removed affecting other commercial users. • Minimal amount of landfill.
Full removal of topsides and jackets: Unplanned operations			
Topside and/ or jacket loss during lifting and transportation.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Water quality. • Sediment biology (benthos). • Finfish and shellfish. • Commercial fishing.	• Detail procedures for heavy lift operations. • Module recovery. • Post-removal survey.	• The area of seabed that will be impacted will be small and localised. • All impacts will be temporary not permanent. • Oil and gas debris (including any dropped objects) will be recovered.

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Loss of minor/ small items e.g. scaffold within 500 m of the platform.	• Seabed integrity/ Physical change. • Water column (plankton). • Finfish and shellfish. • Conservation sites.	• Post-decommissioning debris clearance operations.	• The area of seabed that will be impacted will be small and localised. • All impacts will be temporary not permanent. • Oil and gas debris (including any dropped objects) will be recovered.

Table C.3: Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 decommissioning pipelines *in situ*

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Decommissioning pipelines *in situ*: Planned operations			
Dredging operations to water jet out pipeline at each end (diver operated).	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Water quality. • Sediment biology (benthos). • Finfish and shellfish. • Ecosystem integrity. • Conservation sites.	• Post-decommissioning surveys will be conducted and will build on pre-decommissioning data acquired during the operational phase to determine the status of the pipeline and seabed before and after the proposed operations. • ConocoPhillips will ensure the seabed is safe and overtrawlable for other users of the sea after completion of the jetting or trenching operations. This may involve filling the hole with rock or another material to prevent the hole from being left open should natural infill fail.	• All impacts will be temporary not permanent. • The area of seabed that will be impacted will be small and localised. • Any possible deterioration of water quality will be rapidly dispersed and diluted.
Cutting the pipelines with diamond wires.	• Sediment structure/ chemistry. • Water quality. • Finfish and shellfish. • Ecosystem integrity. • Conservation sites.	• Post-decommissioning surveys will be conducted and will build on pre-decommissioning data acquired during the operational phase to determine the status of the pipeline and seabed before and after the proposed operations.	• Discharges to the marine environment from the cutting operations will be single discrete releases. • Concrete will be benign and last in environment for many years. • The pipeline will be flooded before they are cut, result in the natural dissipation of the pipeline contents. • If any NORM is released from the pipeline contents this will be localised.

Table C.4: Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – LDP1 general decommissioning activities

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
General decommissioning activities: Planned operations			
Physical presence of vessels.	• Commercial fishing. • Shipping. • Government, institution users (e.g. MOD). • Other commercial users. • Recreation and amenity users. • Onshore communities (Resources).	• Refer to Table C.1 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities.	
Operational discharges of treated oily bilge.	• Water quality. • Water column (plankton). • Finfish and shellfish. • Seabirds.	• Refer to Table C.1 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities.	
Waste produced from onsite vessels.	• Air quality (local). • Terrestrial flora & fauna. • Onshore communities (Resources).	• Refer to Table C.1 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities.	
Sewage and grey water discharges.	• Water quality. • Water column (plankton). • Finfish and shellfish.	• Refer to Table C.1 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities.	
Macerated food waste discharge.	• Water quality. • Water column (plankton). • Finfish and shellfish.	• Refer to Table C.1 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities.	
Ballast water uptake and discharge from the vessels on site.	• Sediment biology (benthos). • Water column (plankton). • Finfish and shellfish. • Ecosystem integrity.	• Refer to Table C.1 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities.	
General decommissioning activities: Unplanned operations			
Dropped objects.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Commercial fishing. • Other commercial users.	• Refer to Table C.1 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 general decommissioning activities.	

Table C.5: Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – LDP1 full removal of topsides and jackets

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Full removal of topsides and jackets: Planned operations			
Topside preparation for removal using hot cut, welding, etc.	• Commercial fishing. • Shipping. • Government, institution users(MOD). • Other commercial users. • Recreation and amenity users. • Onshore communities (Resources).	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	
Engineering down and cleaning.	• Finfish and shellfish. • Sea mammals. • Seabirds. • Conservation sites.	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	
Power generation for underwater cutting of jackets legs.	• Water quality. • Air quality (local). • Water column (plankton). • Finfish and shellfish.	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	
Full removal of topsides and jackets: Planned operations			
Power generation for topside separation and cutting (plasma, flame or cold cutting).	• Air quality (local).	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	
Topside separation and cutting (plasma, flame or cold cutting).	• Water quality. • Air quality (local). • Water column (plankton). • Finfish and shellfish.	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	
Power generation for dismantling structures onshore.	• Air quality (local).	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	
Dismantling structures/ recovery of materials onshore.	• Air quality (local). • Land. • Freshwater. • Onshore communities (Resources).	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Full removal of topsides and jackets: Unplanned operations			
Topside and/ or jacket loss during lifting and transportation.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Water quality. • Sediment biology (benthos). • Finfish and shellfish. • Commercial fishing.	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	
Loss of minor/ small items e.g. scaffold within 500 m of the platform.	• Seabed integrity/ Physical change. • Water column (plankton). • Finfish and shellfish. • Conservation sites.	• Refer to Table C.2 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 full removal of topsides and jackets.	

Table C.6: Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – LDP1 Decommissioned *in situ* pipelines

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Decommissioning pipelines *in situ*: Planned operations			
Dredging operations to water jet out pipeline at each end (diver operated).	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Water quality. • Sediment biology (benthos). • Finfish and shellfish. • Ecosystem integrity. • Conservation sites.	• Refer to Table C.3 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 decommissioning pipelines *in situ*.	
Cutting the pipelines with diamond wires.	• Sediment structure/ chemistry. • Water quality. • Finfish and shellfish. • Ecosystem integrity. • Conservation sites.	• Refer to Table C.3 - Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – VDP1 decommissioning pipelines *in situ*.	

Table C.7: Justification for the exclusion of non-significant (low risk) environmental effects from further investigation in the decommissioning – LDP1 Full Removal of LOGGS T-piece

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Full removal of LOGGS T-piece: Planned operations			
Removing grout bags.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Sediment biology (benthos). • Ecosystem integrity. • Conservation sites.	• Post-decommissioning surveys will be conducted and will build on pre-decommissioning data acquired during the operational phase to determine the status of the T-piece, protective structures and seabed before and after the proposed operations.	• All impacts will be temporary not permanent. • The area of seabed that will be impacted will be small and localised.
Removing protective structure.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Sediment biology (benthos). • Ecosystem integrity. • Conservation sites.	• Post-decommissioning surveys will be conducted and will build on pre-decommissioning data acquired during the operational phase to determine the status of the T-piece, protective structures and seabed before and after the proposed operations.	• All impacts will be temporary not permanent. • The area of seabed that will be impacted will be small and localised.
Lift the LOGGS T-piece using DSV.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Water quality. • Sediment biology (benthos). • Finfish and shellfish. • Ecosystem integrity. • Conservation sites.	• As the T-piece will be loaded onto/ transferred to the onsite vessels, it will be placed in a bunded area. • Any spillage will be dealt with accordingly. • Capped and sealed and any waste will be dealt with for treatment and disposal onshore.	• All impacts will be temporary not permanent. • The area of seabed that will be impacted will be small and localised. • Any possible deterioration of water quality will be rapidly dispersed and diluted.
Full removal of LOGGS T-piece: Unplanned operations			
Accidentally dropped sections of T-piece during removal operations.	• Sediment structure/ chemistry. • Seabed integrity/ Physical change. • Water quality. • Sediment biology (benthos). • Finfish and shellfish. • Commercial fishing.	• Detail procedures for heavy lift operations. • Module recovery. • Post-removal survey. • Oil and gas debris (including any dropped objects) will be recovered.	• The area of seabed that will be impacted will be small and localised. • All impacts will be temporary not permanent.

Aspect	Environmental and Societal Receptors/ Concerns	Proposed Control and Mitigation	Justification
Loss of minor/ small items e.g. scaffold within 500 m of the platform.	• Seabed integrity/ Physical change • Water column (plankton) • Finfish and shellfish • Conservation sites	• Post-decommissioning debris clearance operations. • Oil and gas debris (including any dropped objects) will be recovered.	• The area of seabed that will be impacted will be small and localised. • All impacts will be temporary not permanent.

APPENDIX D

ENERGY CONSUMPTION AND GASEOUS EMISSIONS

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Table D.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	NO_x	SO_2	CH_4	
Standard steel	9.0	960	1.6	3.8	ND	IoP (2000)
Copper	25.0	300	ND	120	ND	IoP (2000)

Table D.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)
Concrete	1.0	880	5.4	0.1	ND	IoP (2000)
Plastic (mid-range)*	105.0	3,179	ND	ND	ND	Harvey (2010)*
Aggregate	0.1	5	ND	ND	ND	University of Bath (2008)

* Mid-range energy consumption for 'Plastics' from Harvey (2010); CO_2 expressed as CO2 equivalent emissions from open loop manufacture of plastics from recycled and raw materials from Defra/ DECC (2011).

Table D.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	NO_x	SO_2	CH_4	
Marine diesel	43.1	3,200	59.0	4	0.270	UKOOA (2002)
Aviation fuel	46.1	3,200	12.5	4	0.087	UKOOA (2002)
Diesel fuel	44.0	3,180	40	1	ND	IoP (2000)
Turbine generator	44.0	3,200	13.5	4	0.328	UKOOA (2002)
Engine generator	44.0	3,200	59.4	4	1.800	UKOOA (2002)

Table D.4: Energy consumption and gaseous emissions factors used in the calculations for onshore deconstruction

Operation	Energy consumption (GJ/tonne)	Gaseous emissions (kg/tonne)				Source
		CO_2	NO_x	SO_2	CH_4	
Overall dismantling	1.15	ND	ND	ND	ND	IoP (2000)

Table D.5: Rate of fuel consumption used in vessel energy and emissions calculations

Vessel	Rate of fuel consumption (tonnes/day)*				Source/ comments
	In port	In transit	Working	Waiting on weather	
HLV	10	50	20	25	IoP (2000)
AWV	10	35	25	15	IoP (2000) values for Flotel
Supply vessel	2	10	5	5	IoP (2000)
MSV	2	26	18	9	IoP (2000)
Support vessel/CSV	2	26	18	9	IoP (2000) values for MSV
DSV	3	22	18	10	IoP (2000)
Survey vessel	3	22	18	10	IoP (2000) factors for DSV

APPENDIX E:

UNDERWATER NOISE QUANTIFICATION

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E.1 Noise Quantification

Vessel activity was determined to be the dominant noise source associated with the SNS Decommissioning Project within VDP1 and LDP1 areas. As such, a further investigation using the Marsh-Schulkin model has been undertaken. Equations E1, E2 and E5 have been applied in this study.

Received sound pressure levels (L_r in dB *re* 1 µPa m) for the vessels were determined using the Marsh-Schulkin model (Schulkin & Mercer, 1985). This model applies to acoustic transmission in shallow water (up to 100 fathoms or about 185 m) and represents sound propagation loss (transmission loss, *TL*) in terms of sea state (wave height), substrate type (bottom loss), water depth, frequency and the depth of the mixed layer. A reference parameter, the refractive cycle or skip distance is included, which is a function of the water depth, *D* and *L*, the depth of the mixed layer. Note that the water depth corresponding to the worst-case has been used.

The skip distance (*H* in km) is defined as

$$H = \left(\frac{D + L}{3} \right)^{\frac{1}{2}} \qquad \text{(Equation E1)}$$

[Parameters not defined in the text are defined in Table E.1.]

Consideration is given to the deflection of energy into the seabed at high angles by scattering from the sea surface and the model also uses a simplified Rayleigh two-fluid model of the seabed for sand or mud sediments.

The model allows for the gradual transition from spherical spreading in the near-field to cylindrical spreading in the far-field. The near-field model is used when the range (*R* in km) between the source and the receiver is less than or equal to *H*.

$$L_r = L_S - \left(20\log_{10}(R) + \alpha R - k_L + 60 \right) \qquad \text{(Equation E2)}$$

For intermediate ranges with $H < R \leq 8H$

$$L_r = L_s - \left(5\log_{10}(H) + 15\log_{10}(R) + \alpha R + a_t \left(\frac{R}{H} - 1 \right) - k_L + 60 \right) \qquad \text{(Equation E3)}$$

For the far-field, where $R > 8H$

$$L_r = L_s - \left(10\log_{10}(H) + 10\log_{10}(R) + \alpha R + a_t \left(\frac{R}{H} - 1 \right) - k_L + 64.5 \right) \qquad \text{(Equation E4)}$$

Received sound levels have been modelled for sea states 0 and 5, where sea state 0 gives the most conservative comparisons to the hearing thresholds of marine mammals.

Table E.1: Summary of model input parameters

General information about the project	
Activities	Decommissioning of VDP1 and LDP1 platforms and infrastructures requesting support from various vessels
Location	UKCS Quadrant 48 and 49
Scheduled timing	All months of the year were considered for the modelling of decommissioning operations
Parameter used for modelling	
Water depth (D in m)	Varying between 22.6 m and 34.5 m at the different platforms. Worst case water depth used for modelling: 34.5 m.
Layer depth (L in m)*	Approximately 0 m
Seabed substrate	Sand
Absorption coefficient in seawater (α in dB/km)	Varies with frequency, temperature, salinity and pH, as sourced from NPL on-line calculator using S = 35, T = 8°C and pH = 8[1]
Near-field anomaly (k_L in dB)	Varies with frequency, substrate (sand or mud) and sea state[2]
Attenuation factor (a_t in dB)	Varies with frequency, substrate (sand or mud) and sea state[2]
Frequency range	Vessels: 0.005 to 16 kHz; highest noise levels from 0.125 to 1.25 kHz[3]
Source level (varies with frequency)	Vessel: maximum ~195 dB re 1 µPa m (zero-to-peak) at 0.08 kHz[3] Ambient: maximum ~110 dB re 1 µPa m (rms) at 0.0004 kHz[4]
Marine mammal species potentially present during the decommissioning operations	Minke whale Long-finned pilot whale White-beaked dolphin Atlantic white-sided dolphin Common dolphin Bottlenose dolphin Harbour porpoise Common seal Grey seal

Key: dB re1 µPa m – unit of Sound Pressure Level extrapolated to 1 m range from source
*L determined based on information from the Effects of Sound on the Marine Environment (ESME) software.

Sources: Genesis (2011), Richardson, et al. (1995), Wyatt (2008), [1]NPL (2013), [2]Urick (1983), [3]Hallett (2004), [4]DEWI (2004)

Received sound levels have been modelled for sea states 0 and 5, where sea state 0 gives the most conservative comparisons to the hearing thresholds of marine mammals.

In the literature, underwater sound levels are often presented as spectral densities. These were converted to third-octave band rms sound pressure levels (TOL in dB re 1 µPa (rms)) using

$$\mathrm{TOL} = N_0(f) + 10\log_{10} BW \qquad \text{(Equation E5)}$$

where N_0 is the noise power spectrum level (dB re 1 µPa^2/Hz) and f and BW are the centre frequency and bandwidth of the given TOL (Madsen*, et al.*, 2006). For further conversion from rms to zero-to-peak, 3 dB were added to the rms values.

Values for the attenuation factor and the near-field anomaly parameters used in the Marsh-Schulkin model were only available for frequencies of 0.1 to 10 kHz (Urick (1983), p178, Table 6.2). The estimated radii of displacement for this study all lie within the near-field, calculation of which does not include the attenuation factor (Equation E2).

E.1.1 M-weighting

As a general rule, animals do not hear equally well at all frequencies within their hearing range. Whilst noises are less likely to disturb animals if they are at frequencies that the animal cannot hear well; out of band frequencies can still cause physical injury if pressure levels are very high (Matthews*, et al.*, 2010). Frequency weighting has been developed as a method of quantitatively compensating for the differential frequency response of sensory systems.

For marine mammal species M-weighting functions (Southall*, et al.* (2007), Gentry (2004), Matthews*, et al.* (2010)) have been used as filters to reduce the importance of less-audible/ inaudible frequencies. The M-weighted audiograms can be seen in Figure 8.1. The filters are based on a logarithmic reduction in auditory sensitivity outside of the range of best hearing sensitivity. The filter ascribes a deduction of up to 6 dB down from peak sensitivity at the lower and upper frequency limits. The filters are defined for the broad classes of marine mammals previously described (Table 8.2) and the standard underwater M-weighting curves are shown in Figure E.2.

The general expression for M-weighting is

$$M(f) = 20\log_{10}\left(\left(1+\frac{f_{lo}^2}{f^2}\right)\left(1+\frac{f^2}{f_{hi}^2}\right)\right)$$

where f_{lo} and f_{hi} represent the lower and upper frequency limits of the auditory bandwidth for each group (Table 8.2).

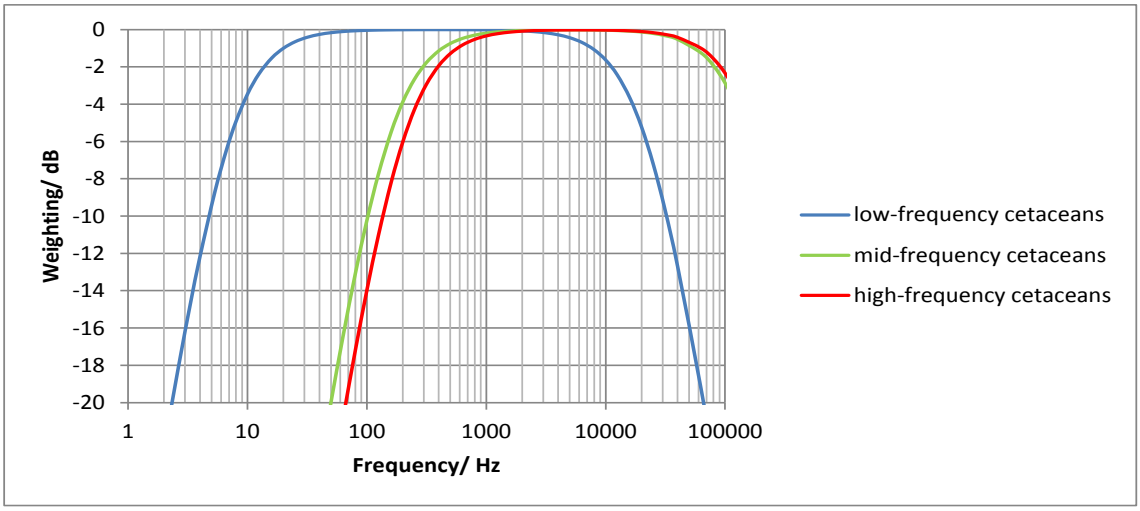

Figure E1: Standard M-weighting curves for low- frequency (Mlf), mid- frequency (Mmf) and high- frequency (Mhf) cetaceans

The amount of deduction applied by M-weighting filters for less audible frequencies is smaller than would be suggested by using species-specific audiograms. It is important to note the incremental nature of the filters, which approximate the gradual reduction in auditory effect at frequencies outside the range of greatest sensitivity.

E.1.2 Results

The M-weighting curve for mid-frequency cetaceans suggests that a negligible 0.1 dB deduction may be applied to the received sound level, as a filter at frequencies of 16 to 20 kHz (Figure E.1). However; as the frequency range for the audiogram of the white-beaked dolphin is quite high compared to audiograms for other mid frequency cetaceans, it may be prudent to consider a deduction as large as 5 to 6 dB, as suggested by the species-specific M-weighting curve (Figure E.2). Applying a filter deduction of this size together with the observed declination in the modelled received sound levels at high frequencies, would counteract the limitations of using only the published parameter values in the Marsh-Schulkin model. This suggests that in terms of any maximum radii determined for the defined auditory zones, the overall results of the model for the white-beaked dolphin are likely to be conservative estimates. It should be noted however, that the use of the filters should be considered precautionary.

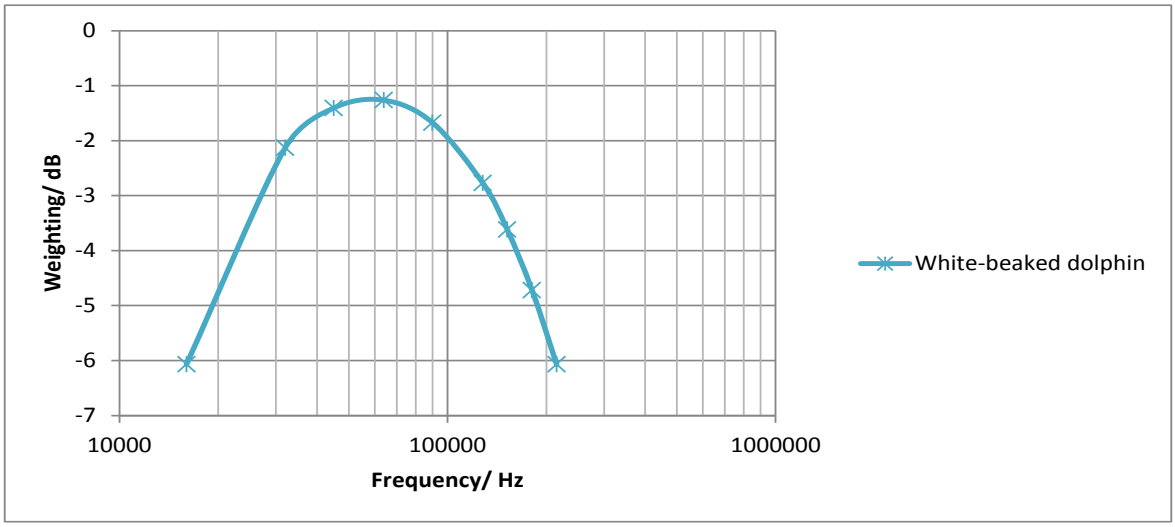

Figure E.2: M-weighting curve for the white-beaked dolphin

E.2 Severity Scale (Southall *et al.,* 2007)

Table E.2: Severity scale for ranking observed behavioural responses of free-ranging marine mammals and laboratory subjects to various types of anthropogenic sound (Southall *et al.,* 2007)

Response score[1]	Corresponding behaviors (Free-ranging subjects)[2]	Corresponding behaviors (Laboratory subjects)[2]
0	- No observable response	- No observable response
1	- Brief orientation response (investigation/visual orientation)	- No observable response
2	- Moderate or multiple orientation behaviors - Brief or minor cessation/modification of vocal behavior - Brief or minor change in respiration rates	- No observable negative response; may approach sounds as a novel object
3	- Prolonged orientation behavior - Individual alert behavior - Minor changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source - Moderate change in respiration rate - Minor cessation or modification of vocal behavior (duration < duration of source operation), including the Lombard Effect	- Minor changes in response to trained behaviors (e.g., delay in stationing, extended inter-trial intervals)
4	- Moderate changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source - Brief, minor shift in group distribution - Moderate cessation or modification of vocal behavior (duration ≈ duration of source operation)	- Moderate changes in response to trained behaviors (e.g., reluctance to return to station, long inter-trial intervals)
5	- Extensive or prolonged changes in locomotion speed, direction, and/or dive profile but no avoidance of sound source - Moderate shift in group distribution - Change in inter-animal distance and/or group size (aggregation or separation) - Prolonged cessation or modification of vocal behavior (duration > duration of source operation)	- Severe and sustained changes in trained behaviors (e.g., breaking away from station during experimental sessions)
6	- Minor or moderate individual and/or group avoidance of sound source - Brief or minor separation of females and dependent offspring - Aggressive behavior related to noise exposure (e.g., tail/flipper slapping, fluke display, jaw clapping/gnashing teeth, abrupt directed movement, bubble clouds) - Extended cessation or modification of vocal behavior - Visible startle response - Brief cessation of reproductive behavior	- Refusal to initiate trained tasks
7	- Extensive or prolonged aggressive behavior - Moderate separation of females and dependent offspring - Clear anti-predator response - Severe and/or sustained avoidance of sound source - Moderate cessation of reproductive behavior	- Avoidance of experimental situation or retreat to refuge area (≤ duration of experiment) - Threatening or attacking the sound source
8	- Obvious aversion and/or progressive sensitization - Prolonged or significant separation of females and dependent offspring with disruption of acoustic reunion mechanisms - Long-term avoidance of area (> source operation) - Prolonged cessation of reproductive behavior	- Avoidance of or sensitization to experimental situation or retreat to refuge area (> duration of experiment)
9	- Outright panic, flight, stampede, attack of conspecifics, or stranding events - Avoidance behavior related to predator detection	- Total avoidance of sound exposure area and refusal to perform trained behaviors for greater than a day

[1]Ordinal scores of behavioral response severity are not necessarily equivalent for free-ranging vs laboratory conditions.
[2]Any single response results in the corresponding score (i.e., all group members and behavioral responses need not be observed). If multiple responses are observed, the one with the highest score is used for analysis.

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APPENDIX F

SURROUNDING INFRASTRUCTURE WITHIN THE NORTH NORFOLK SANDBANKS AND SATURN REEF SCI

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Table F.1: Surface Infrastructure (out-with the scope of VDP1 and LDP1) located within the North Norfolk Sandbanks and Saturn Reef SCI

Name	Type	Status	Operator	Longitude	Latitude	Coordinate system	Installation date
ENSIGN NPA1	PLATFORM	ACTIVE	CENTRICA	617310	5939300	23090	25/04/2005
LEMAN AD	PLATFORM	ACTIVE	PERENCO	448621	5878684	23031	26/04/2002
LEMAN CD (PERENCO)	PLATFORM	ACTIVE	PERENCO	450147	5875601	23031	26/04/2002
VIKING LIMA DRILLING	PLATFORM	ACTIVE	CONOCOPHILLIPS	449077.9	5925587	23031	26/04/2002
GALLEON PN	PLATFORM	ACTIVE	SHELL	627376.8	5925588	23090	26/04/2002
LEMAN BT (PERENCO)	PLATFORM	ACTIVE	PERENCO	452160	5878426	23031	26/04/2002
LEMAN J	PLATFORM	ACTIVE	PERENCO	447641	5876325	23031	26/04/2002
GANYMEDE ZD	PLATFORM	ACTIVE	CONOCOPHILLIPS	449251	5908795	23031	18/10/2013
LOGGS COMPRESSION	PLATFORM	ACTIVE	CONOCOPHILLIPS	433792.6	5916291	23031	26/04/2002
LEMAN AD1	PLATFORM	ACTIVE	SHELL	2.128167	53.0893	4326	26/04/2002
LEMAN AD2	PLATFORM	ACTIVE	SHELL	2.13005	53.08978	4326	26/04/2002
LEMAN AK	PLATFORM	ACTIVE	SHELL	2.129167	53.09007	4326	26/04/2002
LEMAN AP (SHELL)	PLATFORM	ACTIVE	SHELL	2.129183	53.08955	4326	26/04/2002
LEMAN BD (SHELL)	PLATFORM	ACTIVE	SHELL	2.18405	53.07582	4326	26/04/2002
LEMAN BH	PLATFORM	ACTIVE	SHELL	2.179233	53.08028	4326	26/04/2002
LEMAN BP (SHELL)	PLATFORM	ACTIVE	SHELL	2.185067	53.07607	4326	26/04/2002
LEMAN BT (SHELL)	PLATFORM	ACTIVE	SHELL	2.179767	53.08078	4326	26/04/2002
LEMAN CP (SHELL)	PLATFORM	ACTIVE	SHELL	2.161967	53.09643	4326	26/04/2002
LEMAN D	PLATFORM	ACTIVE	SHELL	2.184317	53.00878	4326	26/04/2002
LEMAN E	PLATFORM	ACTIVE	SHELL	2.1869	53.05202	4326	26/04/2002
LEMAN F	PLATFORM	ACTIVE	SHELL	2.0656	53.10803	4326	26/04/2002
LEMAN G (SHELL)	PLATFORM	ACTIVE	SHELL	2.103183	53.1173	4326	26/04/2002
LEMAN AC	PLATFORM	ACTIVE	PERENCO	448728	5878779	23031	26/04/2002
LEMAN AP (PERENCO)	PLATFORM	ACTIVE	PERENCO	448675	5878732	23031	26/04/2002
LEMAN AQ	PLATFORM	ACTIVE	PERENCO	448787	5878831	23031	26/04/2002
LEMAN AX	PLATFORM	ACTIVE	PERENCO	448706	5878818	23031	26/04/2002

Name	Type	Status	Operator	Longitude	Latitude	Coordinate system	Installation date
CLIPPER SOUTH	PLATFORM	ACTIVE	RWE DEA	419207	5918098	23031	03/11/2011
LEMAN H	PLATFORM	ACTIVE	PERENCO	447339	5873217	23031	26/04/2002
LEMAN CD (SHELL)	PLATFORM	ACTIVE	SHELL	2.160833	53.0961	4326	26/04/2002
VIKING ALPHA RISER	PLATFORM	ACTIVE	CONOCOPHILLIPS	450698.2	5932078	23031	26/04/2002
VIKING BRAVO COMPRESSION	PLATFORM	ACTIVE	CONOCOPHILLIPS	455655.8	5922515	23031	26/04/2002
EUROPA	PLATFORM	ACTIVE	CONOCOPHILLIPS	453097.9	5900197	23031	26/04/2002
LOGGS ACCOMMODATION	PLATFORM	ACTIVE	CONOCOPHILLIPS	433881.7	5916200	23031	26/04/2002
NORTH VALIANT 1	PLATFORM	ACTIVE	CONOCOPHILLIPS	433894.3	5916272	23031	26/04/2002
VANGUARD	PLATFORM	ACTIVE	CONOCOPHILLIPS	440903.8	5914848	23031	26/04/2002
VULCAN 1	PLATFORM	ACTIVE	CONOCOPHILLIPS	434908.1	5900408	23031	26/04/2002
NORTH VALIANT 2	PLATFORM	ACTIVE	CONOCOPHILLIPS	436104	5912547	23031	26/04/2002
SOUTH VALIANT	PLATFORM	ACTIVE	CONOCOPHILLIPS	439763.9	5908192	23031	26/04/2002
JUPITER GANYMEDE	PLATFORM	ACTIVE	CONOCOPHILLIPS	449251.7	5908795	23031	26/04/2002
VIKING BRAVO PRODUCTION	PLATFORM	ACTIVE	CONOCOPHILLIPS	455683.6	5922448	23031	26/04/2002
LEMAN BD (PERENCO)	PLATFORM	ACTIVE	PERENCO	452068	5878319	23031	26/04/2002
LEMAN BP (PERENCO)	PLATFORM	ACTIVE	PERENCO	452114	5878373	23031	26/04/2002
LEMAN CP (PERENCO)	PLATFORM	ACTIVE	PERENCO	450192	5875656	23031	26/04/2002
LEMAN DD	PLATFORM	ACTIVE	PERENCO	455737	5874496	23031	26/04/2002
LEMAN DP	PLATFORM	ACTIVE	PERENCO	455793	5874548	23031	26/04/2002
LEMAN ED	PLATFORM	ACTIVE	PERENCO	447123	5879461	23031	26/04/2002
LEMAN EP	PLATFORM	ACTIVE	PERENCO	447168	5879498	23031	26/04/2002
LEMAN FD	PLATFORM	ACTIVE	PERENCO	454070	5877155	23031	26/04/2002
LEMAN FP	PLATFORM	ACTIVE	PERENCO	454134	5877194	23031	26/04/2002
LEMAN G (PERENCO)	PLATFORM	ACTIVE	PERENCO	458541	5876746	23031	26/04/2002
ANGLIA A	PLATFORM	ACTIVE	GDF SUEZ	410377	5914222	23031	26/04/2002
VIKING KILO DRILLING	PLATFORM	ACTIVE	CONOCOPHILLIPS	448501.3	5931513	23031	26/04/2002

Name	Type	Status	Operator	Longitude	Latitude	Coordinate system	Installation date
LOGGS PRODUCTION	PLATFORM	ACTIVE	CONOCOPHILLIPS	433839.3	5916244	23031	26/04/2002
VIKING BRAVO DRILLING	PLATFORM	ACTIVE	CONOCOPHILLIPS	455710.9	5922382	23031	26/04/2002
VICTOR JULIET DRILLING	PLATFORM	ACTIVE	CONOCOPHILLIPS	457618.4	5909097	23031	26/04/2002
LOGGS RISER	PLATFORM	ACTIVE	CONOCOPHILLIPS	433737.4	5916329	23031	26/04/2002
VIKING BRAVO ACCOMMODATION	PLATFORM	ACTIVE	CONOCOPHILLIPS	455564.5	5922580	23031	26/04/2002
AUDREY B (XW)	PLATFORM	ACTIVE	CENTRICA	431842	5936141	23031	18/10/2013
ENSIGN PLATFORM	PLATFORM	PRECOMMISSION	CENTRICA	418898.1	5938877	23031	18/11/2011
WENLOCK NUI	PLATFORM	ACTIVE	ALPHA PETROLEUM	453347.2	5938136	23031	23/10/2006
ANDREA WELLHEAD 48/15B - LIGHTED BUOY	BUOY	ACTIVE	MARITINE CONSULTING	1.867217	53.62633	4326	09/04/2012
LEMAN AC	PLATFORM	ACTIVE	PERENCO	642753.1	5884666	23090	11/11/2014
AUDREY A (WD)	PLATFORM	ACTIVE	CENTRICA	434775	5932966	23031	18/10/2013

Source: UKDeal, 2015.

Table F.2: Subsurface Infrastructure (out-with the scope of VDP1 and LDP1) located within the North Norfolk Sandbanks and Saturn Reef SCI

Name and description	Type	Status	Operator	Longitude	Latitude	Coordinate system	Installation date
STRUCTURE LEMAN 49/27-BP PLATFORM :6989	PROTECTION	ACTIVE	BP	2.284037	53.05098	4326	10/08/2001
STRUCTURE LEMAN 49/27-AP PLATFORM :7001	PROTECTION	ACTIVE	BP	2.232889	53.0539	4326	10/08/2001
ALISON MANIFOLD	MANIFOLD	ACTIVE	CENTRICA	444950.5	5929369	23031	10/08/2001
E+ WELLHEAD (VIXEN)	WELLHEAD	ACTIVE	CONOCOPHILLIPS	449081.9	5917006	23031	05/09/2003
TEEPL0454/0455FUTURE TEE	PIPE JUNCTION	ACTIVE	CONOCOPHILLIPS	1.616503	53.38365	4326	10/08/2001
STRUCTURE SONAR SWEEP AT PLATFORM LEMAN 49/27-BT	PROTECTION	ACTIVE	BP	2.285211	53.05124	4326	10/08/2001
STRUCTURE END SURVEY 50M FROM PLATFORM 49/27-BT	PROTECTION	ACTIVE	BP	2.28748	53.05119	4326	10/08/2001
NW BELL 49/23- 9	WELLHEAD	ACTIVE	PERENCO	460987	5902671	23031	06/05/2004
PIPE EXPOSED AT SUBSEA TEE	PIPE JUNCTION	ACTIVE	BP	2.21738	53.03209	4326	10/08/2001
TEEPL1571/1573VIKING LD TEE	PIPE JUNCTION	ACTIVE	CONOCOPHILLIPS	2.232128	53.47491	4326	10/08/2001
SINOPE TEE	PIPE JUNCTION	ACTIVE	CONOCOPHILLIPS	452551	5903749	23031	10/08/2001
ENSIGN 48/14-ED SUBSEA WELLHEAD 48/14-7Y	WELLHEAD	PRE-COMMISSION	CENTRICA	417729	5940288	23031	18/11/2011
VICTOR NORTH WEST WELLHEAD	WELLHEAD	ACTIVE	CONOCOPHILLIPS	453096.7	5911663	23031	10/08/2001
STRUCTURE PLATFORM 49/27-G	PROTECTION	ACTIVE	BP	2.380032	53.03684	4326	10/08/2001
STRUCTURE LEMAN 49/27-AP PLATFORM :6987	PROTECTION	ACTIVE	BP	2.232548	53.05375	4326	10/08/2001
STRUCTURE LEMAN 49/27-AP PLATFORM :6988	PROTECTION	ACTIVE	BP	2.233637	53.05377	4326	10/08/2001
STRUCTURE LEMAN 49/27-AP PLATFORM :6990	PROTECTION	ACTIVE	BP	2.233162	53.05364	4326	10/08/2001
STRUCTURE LEMAN 49/27-CP	PROTECTION	ACTIVE	BP	2.255905	53.02646	4326	10/08/2001

Name and description	Type	Status	Operator	Longitude	Latitude	Coordinate system	Installation date
PLATFORM :6991							
STRUCTURE PLATFORM LEMAN 49/27-EP	PROTECTION	ACTIVE	BP	2.21051	53.06039	4326	10/08/2001
NW BELL	WELLHEAD	ACTIVE	CONOCOPHILLIPS	459098.5	5899575	23031	10/08/2001
CALLISTO WELLHEAD ZM	WELLHEAD	ACTIVE	CONOCOPHILLIPS	459148.9	5899514	23031	10/08/2001
AUDREY "WM" 7X WELLHEAD CONNECTED TO AUDREY WD PLATFORM	WELLHEAD	ACTIVE	CENTRICA	434325.6	5933059	23031	10/08/2001
RISER 49/27-BT	RISER BASE	ACTIVE	BP	2.285317	53.05128	4326	10/08/2001
TEE-PIECE PL207 CONNECTION	PIPE JUNCTION	ACTIVE	BP	2.217381	53.03203	4326	10/08/2001
RISER 49/27-AP	RISER BASE	ACTIVE	BP	2.233136	53.05361	4326	10/08/2001
TEE PIECE WENLOCK PL2355	PIPE JUNCTION	ACTIVE	ALPHA PETROLEUM	462197.4	5925367	23031	03/05/2007
BLIND FLANGE WENLOCK PL2355	PIG LAUNCH/TRAP	REMOVED	ALPHA PETROLEUM	453382.3	5938086	23031	03/05/2007
WENLOCK CABLE CROSSING PL2355	PROTECTION	ACTIVE	ALPHA PETROLEUM	460956.8	5927254	23031	03/05/2007
ALISON TEE	TEE PIECE	ACTIVE	CENTRICA	444906	5929386	23031	20/06/2003
BURE 'O' WELLHEAD AND PROTECTION STRUCTURE (49/28-8)	WELLHEAD	ACTIVE	PERENCO	461568.6	5886318	23031	27/06/2003
BURE WEST WELLHEAD AND PROTECTION STRUCTURE (49-28-18)	WELLHEAD	ACTIVE	PERENCO	460096.2	5886941	23031	27/06/2003
ENSIGN 2	WELLHEAD	PRE-COMMISSION	CENTRICA	418894.8	5938877	23031	06/05/2008
VICTORIA VALVE SKID	VALVE	ACTIVE	CONOCOPHILLIPS	452521	5924060	23031	18/10/2013
VIKING VALVE SKID	VALVE	ACTIVE	CONOCOPHILLIPS	455753	5922383	23031	18/10/2013
VICTOR JD VALVE SKID	VALVE	ACTIVE	CONOCOPHILLIPS	457610	5909126	23031	18/10/2013
VIXEN VM WELL	WELLHEAD	ACTIVE	CONOCOPHILLIPS	449081	5917006	23031	18/10/2013
MID FLANGE 642537.09	VALVE	ACTIVE	SHELL	642537.1	5884296	23090	04/11/2014

Source: UKDeal, 2015.

Table F.3: Pipelines (out-with the scope of VDP1 and LDP1) located within/ transecting the North Norfolk Sandbanks and Saturn Reef SCI

Pipeline ID	Pipeline name	Diameter (“)	Pipeline type	Status	Operator	Installation date
PL2355	WENLOCK GAS EXPORT SPOOL PIECE	8	GAS	ACTIVE	ALPHA PETROLEUM	06/11/2007
PL2356	WENLOCK SERVICE SPOOL PIECE	3	CHEMICAL	ACTIVE	ALPHA PETROLEUM	06/11/2007
PL2526	LX1 WELL TO VIKING BRAVO	6	GAS	ACTIVE	CONOCOPHILLIPS	04/11/2008
PL212	VICTOR JD TO VIKING BD MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1611	CORVETTE TO LEMAN AP	4.5	METHANOL	ACTIVE	SHELL	30/10/2006
PL855	LOGGS PP TO ANGLIA YD MEOH LINE	3	METHANOL	ACTIVE	ITHACA	04/09/2003
PL2644	LOGGS TO VIKING METHANOL	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/05/2010
PL2355	WENLOCK GAS PIPELINE	8	GAS	ACTIVE	ALPHA PETROLEUM	03/05/2007
PL947	ANN XM TO LOGGS PR	12	GAS	ACTIVE	CENTRICA	07/08/2001
PL370	BACTON TO THAMES	24	GAS	ACTIVE	PERENCO	07/08/2001
PL108	LEMAN 49/27 EP TP 49/27 AP	20	GAS	ACTIVE	PERENCO	07/08/2001
PL1610	CORVETTE A TO LEMAN A	20	GAS	ACTIVE	SHELL	07/08/2001
PL2643	VIKING TO LOGGS GAS EXPORT	16	GAS	ACTIVE	CONOCOPHILLIPS	04/05/2010
PL2838	ENSIGN NPAI TO AUDREY WD GAS EXPORT	10	GAS	ACTIVE	CENTRICA	18/11/2011
PL2841	ENSIGN PRODUCTION PIPELINE	10	GAS	NOT IN USE	CENTRICA	18/11/2011
PL2839	AUDREY TO ENSIGN METHANOL LINE	2	METHANOL	ACTIVE	CENTRICA	18/11/2011
PLU2840	ENSIGN CONTROL & CI UMBILICAL	5	HYDRAULIC	NOT IN USE	CENTRICA	18/11/2011
PL3027	8IN GAS LEMAN 53/02-14A TO LEMAN 27A	8	GAS	ACTIVE	PERENCO	03/05/2013
PL2810	CLIPPER SOUTH TO LOGGS GAS PIPELINE	unknown	GAS	ACTIVE	RWE	16/10/2012
PL2811	LOGGS TO CLIPPER SOUTH METHANOL PIPELINE	unknown	METHANOL	ACTIVE	RWE	16/10/2012
PLU2527	VIC VALVE SKID TO VIKING BD VALVE SKID	6	METHANOL	ACTIVE	CONOCOPHILLIPS	19/03/2014
PL1091	CALLISTO ZM TO GANYMEDE ZD GAS LINE	12	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL1093	GANYMEDE ZD TO LOGGS PR GAS LINE	18	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001

Pipeline ID	Pipeline name	Diameter (“)	Pipeline type	Status	Operator	Installation date
PL1571	VIKING KD TO VIKING BD GAS LINE	16	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL1095	VICTOR JM TO VICTOR JD GAS LINE	12	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL632	CLIPPER PT TO BACTON	24	GAS	ACTIVE	SHELL	07/08/2001
PL105	LEMAN BT TO LEMAN BP (NOT IN USE)	4	N/A	NOT IN USE	SHELL	07/08/2001
N/A	GALLEON PN TO SKIFF	unknown	POWER CABLE	ACTIVE	SHELL	07/08/2001
PL954	ANGLIA YD TO ANGLIA YM GAS LINE	8	GAS	ACTIVE	ITHACA	07/08/2001
PL854	LOGGS PP TO ANGLIA YD GAS LINE	12	GAS	ACTIVE	ITHACA	07/08/2001
PL110	LEMAN 49/27 FP 49/27 BT	20	GAS	ACTIVE	PERENCO	07/08/2001
PL109	LEMAN 49/27 BT TO 49/27 DP	30	GAS	ACTIVE	PERENCO	07/08/2001
PL107	LEMAN 49/27 CP TP 49/27 AP	20	GAS	ACTIVE	PERENCO	07/08/2001
PL106	LEMAN 49/27 BP TO 49/27 AP	20	GAS	ACTIVE	PERENCO	07/08/2001
N/A	LEMAN BP TO LEMAN E	1	POWER CABLE	ACTIVE	SHELL	07/08/2001
PL455	LOGGS PP TO THEDDLETHORPE MEOH LINE	4	METHANOL	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL371	BURE TO THAMES	8	GAS	ACTIVE	PERENCO	07/08/2001
PL1635	BURE WEST TO THAMES	8	GAS	ACTIVE	PERENCO	07/08/2001
PL576	AUDREY WD TO AUDREY WM	1	CHEMICAL	ACTIVE	CENTRICA	07/08/2001
PL497	AUDREY WD TO LOGGS PP MEOH LINE	3	METHANOL	ACTIVE	CENTRICA	07/08/2001
PL724	AUDREY XW TO AUDREY WD MEOH LINE	3	METHANOL	ACTIVE	CENTRICA	07/08/2001
PL364	LEMAN G TO LEMAN F	14	GAS	ACTIVE	SHELL	07/08/2001
PL363	LEMAN F TO LEMAN AK	20	GAS	ACTIVE	SHELL	07/08/2001
PL311	SEAN PP TO BACTON	30	GAS	ACTIVE	SHELL	07/08/2001
PL25	LEMAN AP TO BACTON	30	GAS	ACTIVE	SHELL	07/08/2001
PL251	LEMAN 49/27 G TO 49/27 BT	24	GAS	ACTIVE	PERENCO	07/08/2001
PL24	LEMAN BT TO BACTON A2	30	GAS	ACTIVE	PERENCO	07/08/2001
PL23	LEMAN 49/27 AP TO BACTON A1	30	GAS	ACTIVE	PERENCO	07/08/2001
PL22	INDEFATIGABLE JOINT 49/23 AT TO 49/27 BT	30	GAS	ACTIVE	PERENCO	07/08/2001
PL206	LEMAN 49/27 H TO 49/27 AC	20	GAS	ACTIVE	PERENCO	07/08/2001

Pipeline ID	Pipeline name	Diameter (“)	Pipeline type	Status	Operator	Installation date
PL102	LEMAN E TO LEMAN BP	20	GAS	ACTIVE	SHELL	07/08/2001
PL101	LEMAN BT (PERENCO) TO LEMAN BT (SHELL)	30	GAS	ACTIVE	SHELL	07/08/2001
PL100	LEMAN D TO LEMAN BT	24	GAS	ACTIVE	SHELL	07/08/2001
PL29	LEMAN 49/26-BT TO BACTON	30	GAS	ACTIVE	SHELL	07/08/2001
PL470/ PL471	NORTH VALIANT SP TO LOGGS	10	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL460/ PL461	SOUTH VALIANT TD TO LOGGS PP GAS LINE	10	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL458/ PL459	VULCAN RD TO LOGGS PP GAS LINE	18	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL456/ PL457	VANGUARD QD TO LOGGS PP GAS LINE	10	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL454	LOGGS PP TO THEDDLETHORPE GAS LINE	36	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL27	VIKING AR TO THEDDLETHORPE GAS LINE	28	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL211	VICTOR JD TO VIKING BD GAS LINE	16	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL1694	EUROPA EZ TO PL1091 TEE GAS LINE	330	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
PL723	AUDREY XW TO AUDREY WD GAS LINE	14	GAS	ABANDONED	CENTRICA	07/08/2001
PL575	AUDREY WM TO AUDREY WD	8	GAS	ACTIVE	CENTRICA	07/08/2001
PL496	AUDREY WD TO LOGGS PP GAS LINE	20	GAS	ACTIVE	CENTRICA	07/08/2001
PL624	CAMELOT CA GAS EXPORT TO LEMAN 27A	12	GAS	ABANDONED	ENERGY RESOURCE TECHNOLOGY	07/08/2001
PL253	ESMOND TO BACTON	24	GAS	ACTIVE	PERENCO	07/08/2001
PL88	VIKING AR TO VIKING BP GAS LINE	24	GAS	ACTIVE	CONOCOPHILLIPS	07/08/2001
N/A	LEMAN AK TO LEMAN F	4	POWER CABLE	ACTIVE	SHELL	07/08/2001
N/A	LEMAN F TO LEMAN G	4	POWER CABLE	ACTIVE	SHELL	07/08/2001
PL994	GALLEON PN TO CLIPPER PM	14	GAS	ACTIVE	SHELL	07/08/2001
PL98	LEMAN BP TO LEMAN BT	24	GAS	ACTIVE	SHELL	07/08/2001
PL97	LEMAN BT TO LEMAN AP	30	GAS	ACTIVE	SHELL	07/08/2001

Pipeline ID	Pipeline name	Diameter (“)	Pipeline type	Status	Operator	Installation date
UM1	VICTOR JD TO VICTOR JM	unknown	UMBILICAL	ACTIVE	CONOCOPHILLIPS	07/08/2001
UM2	GANYMEDE ZD TO CALLISTO ZM	unknown	UMBILICAL	ACTIVE	CONOCOPHILLIPS	07/08/2001
N/A	CLIPPER PM TO GALLEON PN ELEC	2	POWER CABLE	ACTIVE	SHELL	07/08/2001
N/A	LEMAN BP TO LEMAN BH	unknown	POWER CABLE	ACTIVE	SHELL	07/08/2001
PL1967	CARRACK QA TO CLIPPER PR	20	GAS	ACTIVE	SHELL	06/11/2003
PL1968	CLIPPER PR TO CARRACK QA	4	METHANOL	ACTIVE	SHELL	06/11/2003
PL996	BACTON TO CLIPPER PT	3.5	CHEMICAL	ACTIVE	SHELL	20/09/2001
N/A	LEMAN AP TO SSIV	4	UMBILICAL	ACTIVE	SHELL	07/08/2001
PL948	AUDREY XW TO ANN XM	4	CHEMICAL	ACTIVE	CENTRICA	07/08/2001
PL121	BACTON TO LEMAN AP	4	CHEMICAL	ACTIVE	SHELL	07/08/2001
PL995	CLIPPER PM TO GALLEON PN MEG	2	CHEMICAL	ACTIVE	SHELL	07/08/2001
PL104	LEMAN AP TO LEMAN BT	4	CHEMICAL	ACTIVE	SHELL	07/08/2001
PL103	LEMAN AP TO LEMAN CD	8	CHEMICAL	NOT IN USE	SHELL	07/08/2001
PL99	LEMAN CP TO LEMAN BT	24	GAS	ACTIVE	SHELL	07/08/2001
PL2066	ANNABEL TO AUDREY A	10	GAS	ACTIVE	CENTRICA	27/04/2005
PL2077	AUDREY B TO ANNABEL	unknown	UMBILICAL	ACTIVE	CENTRICA	27/04/2005
PL2107	SATURN ND TO LOGGS PR	14	GAS	ACTIVE	CONOCOPHILLIPS	02/11/2005
PL2108	LOGGS PR TO SATURN ND	3	METHANOL	ACTIVE	CONOCOPHILLIPS	02/11/2005
PL1099	AUDREY XW TO ALISON KX	4	UMBILICAL	ACTIVE	CONOCOPHILLIPS	23/06/2003
PL134	VIKING AR TO VIKING BP MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL161	VIKING AR TO THEDDLETHORPE MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL457	VANGUARD QD TO LOGGS PP MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL459	VULCAN RD TO LOGGS PP MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL461	SOUTH VALIANT TD TO LOGGS PP MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL471	NORTH VALIANT SP TO LOGGS PP	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL955	ANGLIA YD TO ANGLIA YM UMBILICAL	6	HYDRAULIC	ACTIVE	ITHACA	04/09/2003
PL1092	CALLISTO ZM TO GANYMEDE ZD MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003

Pipeline ID	Pipeline name	Diameter (“)	Pipeline type	Status	Operator	Installation date
PL1094	GANYMEDE ZD TO LOGGS PR MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1096	VICTOR JM TO VICTOR JD MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1573	VIKING KD TO VIKING BD MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1572	VIKING LD TO PL1571 TEE	16	GAS	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1574	VIKING LD TO PL1573 TEE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1690	NW BELL ZX TO CALLISTO ZM GAS LINE	8	GAS	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1691	NW BELL ZX TO CALLISTO ZM MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1695	EUROPA EZ TO PL1091 TEE MEOH LINE	3	METHANOL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1767	VIXEN VM TO VIKING BD GAS LINE	12	GAS	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL1705	NW BELL TO BESS E	6	GAS	ACTIVE	PERENCO	28/09/2001
PL1706	BESS TO NW BELL	5	UMBILICAL	ACTIVE	PERENCO	28/09/2001
PL2356	WENLOCK SERVICE PIPELINE	3	CHEMICAL	ACTIVE	ALPHA PETROLEUM	03/05/2007
PL625	CAMELOT CA MEG IMPORT FROM LEMAN 27A	3	CHEMICAL	ABANDONED	ENERGY RESOURCE TECHNOLOGY	03/05/2007
PL1768	VIXEN VM TO VIKING BD UMB	10	UMBILICAL	ACTIVE	CONOCOPHILLIPS	04/09/2003
UM3	NW BELL ZX TO CALLISTO ZM UMBILICAL	3	UMBILICAL	ACTIVE	CONOCOPHILLIPS	04/09/2003
PL374	THAMES TO BURE	0.5	CHEMICAL	ACTIVE	PERENCO	04/11/2003
PL1636	THAMES TO BURE WEST	0.75	CHEMICAL	ACTIVE	PERENCO	04/11/2003

Source: UKDeal, 2015

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