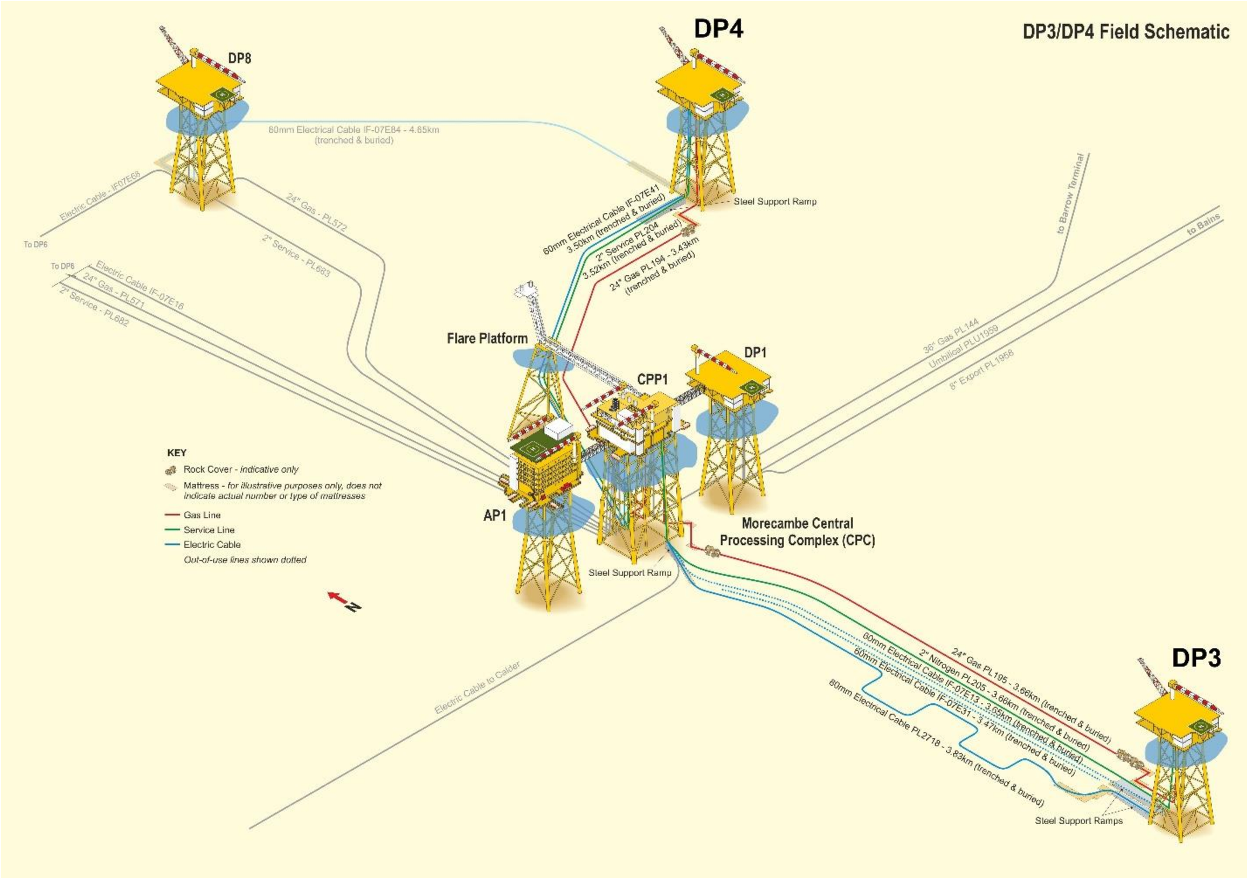
South Morecambe DP3-DP4 Decommissioning Environmental Appraisal



SPIRIT ENERGY

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Revision Record

Revision No.	**Date of Revision**	**Reason**
A1	19/10/17	Issued for Client Comment
A2	27/11/17	Updated with client comments
A3	15/01/18	Updated with client comments
A4	30/10/18	Issued for client comment
A5	22/11/18	Issued to OPRED for review and comment
A6	12/02/19	Updated and Issued for Statutory Consultation

INFORMATION SHEET

Project name:	South Morecambe DP3-DP4 Decommissioning Project	
Type of project:	Decommissioning	
Undertaker name:	Spirit Energy Production UK Limited	
Undertaker address:	Millstream, Maidenhead Road, Windsor SL4 5GD	
Spirit Energy doc. ref. no:	CEU-PRJ-EIS0041-REP-0010	
Section of UKCS:	East Irish Sea	
Distance from English Coast:	Approximately 30km	
Water depth (LAT):	Approximately 22-25m LAT	
Licence Blocks:	110/3a and 110/8a	
Licences/owners:	Spirit Energy Production UK Limited is the nominated operator	
	Spirit Energy Production UK Limited	100%
Short description:	Spirit Energy proposes to remove and recover to shore, for preferential recycling, the DP3 and DP4 installation topsides and jackets, with the exception that portion of the jacket foundation piles which will be decommissioned *in situ* below the seabed. Pipelines and cables approaching DP3 and DP4 will be cut at a point at which they are sufficiently buried, and sections not sufficiently covered by sediment will be removed and recovered to shore for preferential recycling along with associated protection and stabilisation features, including mattresses and grout bags.	
Anticipated date for commencement of works:	Q2 2020	
Significant environmental impacts identified:	The significance of the impacts of all planned activities, following the application of control and mitigation measures, is assessed as low, except for those that will result in seabed disturbance, the impacts of which are evaluated as medium and 'as low as reasonably practicable'. The significance of the risk associated with an unplanned (accidental) large hydrocarbon release, again following control and mitigation, is assessed as medium and 'as low as reasonably practicable' This EA assesses the worst-case impacts of the project on the environment and is therefore very conservative. It concludes that, by applying the mitigation measures identified, the decommissioning of DP3 and DP4, including associated pipelines and cables, can be completed without causing any significant long term environmental impacts or cumulative and transboundary impacts.	
EA prepared by:	Genesis Oil and Gas Consultants Ltd. and Spirit Energy	

ACRONYMS AND ABBREVIATIONS

ACRONYM	DESCRIPTION
AHT	Anchor Handling Tug
AIS	Automatic Identification System
BEIS	The Department of Business, Energy and Industrial Strategy
CA	Comparative Assessment
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CPP	Central Processing Platform (as in CPP1)
CPC	Central Production Complex
CSV	Construction Support Vessel
dB	Decibel
DP	Drilling Platform (as in DP3 and DP4)
DECC	Department of Energy and Climate Change
DSV	Dive Support Vessel
EA	Environmental Appraisal
EIA	Environmental Impact Assessment
EIS	East Irish Sea
EMS	Environmental Management System
E&P	Exploration and Production
EPS	European Protected Species
ERL	Effects Range Low
ESAS	European Seabirds at Sea
EUNIS	European Nature Information System
GJ	Gigajoule
Hz	Hertz
HLV	Heavy Lift Vessel
HSE	Health and Safety Executive
ICES	International Council for the Exploration of the Sea
IoP	Institute of Petroleum
IoM	Isle of Man
JNCC	Joint Nature Conservation Committee
ISO	International Organisation for Standardisation

ACRONYM	DESCRIPTION
JUWB	Jack Up Work Barge
kHz	Kilohertz
km	Kilometre
LAT	Lowest Astronomical Tide
m	Metre
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multibeam Echosounder
MCZ	Marine Conservation Zone
ms^{-1}	Metre per second
MNR	Marine Nature Reserve
MTe	Million Tonnes
MU	Management Unit
nm	Nautical Mile
NFFO	National Federation of Fishermen's Organisations
NOAA	United States National Oceanic and Atmospheric Administration
NORM	Naturally Occurring Radioactive Material
NO_x	Generic term for the nitrogen oxides
NUI	Normally Unattended Installation
OCR	Offshore Chemicals Regulations
OGA	Oil and Gas Authority
OPEP	Oil Pollution Emergency Plan
OPPC	Oil Pollution Prevention and Control
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSCAR	Oil Spill Contingency and Response model
OSPAR	OSlo and PARis Convention
PAH	Polycyclic Aromatic Hydrocarbon
PL	Pipeline Identification Numbers (UK)
pMCZ	Proposed Marine Conservation Zone
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SCANS	Small Cetacean Abundance in the North Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SOSI	Seabird Oil Sensitivity Index

ACRONYM	DESCRIPTION
SO_2	Sulphur Dioxide
SO_x	Generic term for the sulphur oxides
SPA	Special Protection Area
SSCV	Semi-Submersible Crane Vessel
SSS	Sidescan Sonar
Te	Tonne (1,000 kg)
THC	Total Hydrocarbon Concentration

ACRONYM	DESCRIPTION
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
µm	Micrometre (one millionth of a metre or one thousandth of a millimetre - 0.001mm)
VOC	Volatile Organic Compound
%	Percentage/Parts per hundred
"	Inch (25.4mm)

GLOSSARY OF TERMS

TERM	DESCRIPTION
Anti-scour support ramp	Structures used to support small pipelines and cables as they approach the installations. The inboard end of the support ramps hook over a bottom brace of the jackets while the outboard end rests on bitumen mattresses
Approach	Initial or final stretch of pipeline or cable as it leaves its point of origin or reaches its destination.
Aspect	Element of an organisations activities, products or services that can interact with the environment. (ISO 14001:2015).
Benthos	The community of organisms that live on, or in, the seabed.
Best Practicable Environmental Option (BPEO)	Emphasises the protection and conservation of the environment across land, air and water. The BPEO procedure establishes for a given set of objectives, the option that provides the most benefits or the least damage to the environment, as a inwhole, at acceptable cost, in the long term as well as in the short term.
Biotope	A biotope is an area of uniform environmental conditions providing a living place for a specific assemblage of plants and animals.
Circalittoral	A marine biological zone defined by depth and related factors including the amount of wave energy experienced at the seabed; the degree of thermal stability; and the proportion of surface light reaching the sea floor. The circalittoral is defined at its upper limit as the depth at which 1% light reaches the seabed, and its lower limit by the maximum depth to which the passage of a wave causes motion in the water column. The deep circalittoral zone extends deeper than this, to the 200m depth contour.
Demersal fish	Fish species that live on or near the seabed and feed on bottom-living organisms and other fish.
Demersal gear	Fishing gear that is operated on or close to the seabed.
Effects Range Low (ERL)	The concentration below which toxic effects are scarcely observed or predicted.
Impact	Any change to the environment wholly or partially resulting from an operational activity environmental aspect (ISO 14001:2015).
Infauna	Animals living in the sediments of the ocean floor or river or lake beds.
Infrastructure	General term to describe any of platform (jackets, topsides), template/manifold, well, wellhead, Xmas tree, pipeline, umbilical, stabilisation and protection features.
Jack-up	A self-contained combination drilling rig and floating vessel, fitted with long support legs that can be raised or lowered independently of each other.
Kingfisher Information Service	Kingfisher work with all the offshore industries, including oil and gas, subsea cable, renewable energy and marine aggregates to provide fishermen with two updates per year of the most accurate and up-to-date positions regarding surface and subsea structures as well as infrastructure.
Materials	Anything that has been recovered to shore for processing.
Megaripples	Large sandwaves or ripple-like features having wavelengths greater than 1m or a ripple height greater than 10cm.
Metocean	A contraction of the words 'meteorology' and 'oceanology' referring to the wave, wind and current conditions that affect offshore operations.
OSPAR 2006/5	OSPAR Recommendation 2006/5 aims to reduce the impacts of pollution from cuttings piles to a level that is not significant. It sets thresholds for the rate of

TERM	DESCRIPTION
thresholds	oil lost from the cuttings pile to the water column, and the area of the seabed where the concentration of oil remains above 50mg/kg and the duration that this contamination level remains (persistence). Where both the rate and persistence are below the thresholds no further action is necessary and the cuttings pile may be left in situ to degrade naturally.
Semidiurnal	With respect to tides, a semidiurnal tidal cycle is two high and two low tides of approximately equal size every lunar day.
Spirit Energy	Spirit Energy Production UK Limited (formerly Hydrocarbon Resources Limited)
Sidescan Sonar (SSS)	SSS uses an acoustic beam to generate an image of the seabed by measuring the amplitude of back-scattered return signals.

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1. EXECUTIVE SUMMARY

This summary outlines the findings of the Environmental Appraisal (EA) conducted by Spirit Energy Production UK Limited (hereafter referred to as Spirit Energy) for the proposed decommissioning of the South Morecambe Field Drilling Platform 3 (DP3) and DP4 installations and associated infrastructure located in the east Irish Sea (EIS), Blocks 110/8a and 110/3a respectively.

The purpose of the report is to record and communicate the findings of the EA, which considered the potential for, and the significance of, environmental and socio-economic impacts resulting from the proposed decommissioning activities. This report supports the Decommissioning Programmes [96].

1.1 Summary of project

In accordance with the Petroleum Act 1998, as operator of the South Morecambe Field, Spirit Energy is applying to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) to obtain approval to decommission the DP3 and DP4 platforms and associated pipelines and cables.

Spirit Energy plans to remove and recover to shore, for preferential recycling, the platform topsides and jackets, except for the larger part of the jacket foundation piles which will be decommissioned *in situ* below seabed. Pipelines and cables approaching DP3 and DP4 will be cut at a point at which they are sufficiently buried, and sections not sufficiently covered by sediment will be removed and recovered to shore for preferential recycling along with associated protection and stabilisation features (including mattresses and grout bags). At CPP1 and DP8 the pipeline and cable ends will be decommissioned at the same time as the respective installations. A summary of the proposed decommissioning solutions and associated activities provided in Table 1.1.1.

<table>
<tr><th>ITEM</th><th>PROPOSED DECOMMISSIONING SOLUTIONS</th><th>METHOD</th></tr>
<tr><td>Topsides</td><td>Complete removal and recovery to shore.</td><td>The preference is to remove the topsides from the jackets using a heavy lift vessel (HLV) and recover them to shore for preferential recycling.</td></tr>
<tr><td>Jackets</td><td>Complete removal and recovery to shore, except for the bottom sections of the jacket foundation piles which will be decommissioned in situ.</td><td>The preference is to remove the jackets from the seabed as single units using a HLV and recover them to shore for preferential recycling.
To facilitate this, the jacket foundation piles will be cut approximately 1m below natural seabed.</td></tr>
<tr><td>Pipelines
DP3: PL195, PL205
DP4: PL194, PL204</td><td>Removal of the end sections at DP3, DP4, CPP1 and DP8 that are not sufficiently buried, and recovery to shore.</td><td rowspan="3">The end sections at DP3, DP4 and CPP1 will be cut at the point at which they are sufficiently buried and recovered to shore for preferential recycling.
Local excavation of sediment will be required to enable access.</td></tr>
<tr><td>Power and fibre-optic cables
DP3: PL2718
DP4: IF-07E84</td><td>Removal of the end sections at DP3, DP4, CPp1 and DP8 that are not sufficiently buried, and recovery to shore.</td></tr>
<tr><td>Electrical cables
DP3: IF-07E13, IF-07E31
DP4: IF-07E41</td><td>Removal of the end sections at DP3, DP4 and CPP1 that are not sufficiently buried and recovery to shore.</td></tr>
<tr><td>Anti-scour support ramps</td><td>Complete removal and recovery to shore.</td><td>A total of three anti-scour support ramps, which are attached to the DP3 (two ramps) and DP4 (one ramp) jacket bottom braces, will be removed and recovered to shore for preferential recycling.</td></tr>
</table>

ITEM	PROPOSED DECOMMISSIONING SOLUTIONS	METHOD
Mattresses and grout bags	Complete removal and recovery to shore, except for mattresses buried under deposited rock that will not be removed.	The items will be lifted from the seabed and recovered to shore for preferential recycling. Local excavation may be required to allow access for removal.
Note: Management of recovered materials will be in accordance with the waste hierarchy.		

Table 1.1.1: Summary of proposed decommissioning solutions

1.2 Environmental baseline

The DP3 and DP4 platforms are in the east Irish Sea (EIS) in water depths of approximately 22m and 25m respectively, with localised seabed depressions of up to 1.5m around some of the platform legs. Tides in the EIS are semi-diurnal and there is a large tidal range of up to approximately 7.9m. Tidal currents are moderate, in the range 0.5-1.5ms^{-1}, but decrease with depth and peak at approximately 0.5ms^{-1} at the seabed.

The seabed in the area is characterised by fine sediments consisting mud and sand, with small areas interpreted as gravel with sand patches around the bases of the platforms. Geophysical data did not identify any seabed features or hard substrate indicative of habitats of conservation value. The seabed, in most areas, is likely to be classed as 'circalittoral sandy mud', based on information from nearby environmental surveys. This seabed is characterised by burrowing species including polychaete worms and the bivalve mollusc *Mysella bidentate.* Brittlestars were the most conspicuous surface fauna at the nearest survey locations, including the often abundant *Amphiura filiformis*. However, the seabed characteristics around DP3 and DP4, including seabed type, sediment chemistry, and seabed fauna, will be confirmed by a pre-decommissioning environmental survey prior to project execution.

Spawning grounds for a number of fish species have been identified within the area including, but not limited to, cod, mackerel, *Nephrops*, plaice, sandeel, sole, and whiting. In addition, the area coincides with nursery grounds for these and other species.

Distribution and abundance data indicates that whale and dolphin species including harbour porpoise, bottlenose dolphin, and white beaked dolphin occur in the EIS at relatively low densities, with harbour porpoise being the most common. Grey seals may be present in low numbers.

European Seabirds at Sea (ESAS) data suggests that seabirds do not use the area around DP3 and DP4 in high numbers, predicting a maximum of 9 seabirds per square kilometre during the breeding season (March to September), and 4 seabirds per square kilometre in winter (November to March). Seabird Oil Sensitivity Index (SOSI) data indicates that sensitivity to oil pollution is high from October to March, reducing through the spring as seabirds migrate to coastal breeding areas, and is lowest between June and October when sensitivity is considered medium to low (except in August when sensitivity is considered to be high around DP4). Additionally, parts of the EIS coastline, particularly estuaries, are nationally and internationally important for a variety of breeding and wintering seabirds, as well as for migrant and wintering wildfowl and wading birds.

DP4 is located within the Liverpool Bay/Bae Lerpwl Special Protection Area (SPA) and DP3 is located 1.4km to the south of its boundary. The SPA is designated to protect an internationally important waterbird assemblage, including little gull (*Hydrocoloeus minutus*) in offshore areas. There are numerous protected areas around the EIS coastline, many designated for intertidal sand and mud flats and their associated bird populations. To the north and east of DP3 and DP4 there are offshore marine protected areas protecting seabed habitats.

Fisheries statistics for this part of the EIS, defined by International Council for the Exploration of the Sea (ICES) rectangle 36E6, show that shellfish make up 97% of landings by weight and 96% by value landings. Fishing activity is concentrated to the south and west and is relatively low around

DP3 and DP4.

Shipping density is classed as moderate to high around DP3 and DP4. DP3 is located close to a shipping lane for cargo vessels and fishing vessels transiting to fishing grounds.

Other offshore activities and infrastructure in the EIS are associated with oil and gas, offshore wind, marine aggregate extraction, submarine power and communication cables, and military exercise areas. The nearest to DP3 and DP4, excluding South Morecambe Field infrastructure, is the GTT Atlantic telecommunications cable located approximately 3km south of DP3 and Bispham IoM Electrical Interconnector, located approximately 3.5km northeast of DP4.

1.3 Impact assessment

The Environmental Impact Assessment (EIA) process presented in this EA report considers the impact of the planned activities associated with the decommissioning of DP3 and DP4. Impacts are evaluated (on a scale of 'low' to 'high' significance) as a function of their extent and duration (recovery time) given the application of industry standard control and mitigation measures.

The potential impacts of unplanned (accidental) events are also considered following a similar process. After assessment of the impact however, the risk of impact is evaluated by factoring in the likelihood of occurrence.

Following assessment, impacts or risks which have been categorised as of 'low' significance are not subject to further assessment. Those categorised as of 'medium' or 'high' significance are assessed in more detail, with additional control and mitigation measures being considered to reduce impacts and risks to a level that is 'as low as reasonably practicable'.

1.3.1 Summary of assessment

The EA concludes that the overall significance of planned impacts, following the adoption of identified control and mitigation measures, would be **low**, except for seabed disturbance which is assessed as **medium**.

The activities responsible for the most significant seabed disturbance are the overtrawl assessment and the deployment of vessel anchors. A proportion of the seabed fauna will be injured or killed. Recovery will commence as soon as activities have been completed through immigration and larval recruitment and is expected to be largely complete within three years. The species associated with the areas are relatively widespread throughout the EIS and the area anticipated to be impacted represents a very small percentage of the available habitat.

The EA assessed the significance, again following control and mitigation, of the risk associated with an unplanned (accidental) large hydrocarbon release as **medium**.

The worst case would be loss to sea of the entire hydrocarbon inventory of the HLV while at DP3 or DP4. Potential impacts on seabirds, depending on the time of year, could be high, as could the impact on coastal protected sites. However, such an event is highly unlikely. This risk will be managed to a level that is 'as low as reasonably practicable' under existing marine procedures and the Morecambe Hub Oil Pollution Emergency Plan (OPEP), with amendments if required.

1.4 Control and mitigation measures

A summary of proposed control and mitigation measures is shown in Table 1.4.1.

CONTROL AND MITIGATION MEASURES
General and Existing
• Lessons learnt from previous decommissioning scopes will be reviewed and implemented as appropriate; • Vessels will be managed in accordance with Spirit Energy's marine procedures, including where applicable, the consent to locate process; • The vessels' work programme will be optimised to minimise vessel use; • There is a comprehensive management and operational controls plan developed to minimise the likelihood of large hydrocarbon releases, and to mitigate their impacts should they occur. This includes the OPEP; • All vessels undertaking decommissioning activities will have an approved SOPEP; • Existing contractor management processes will be used to reduce environmental impacts and risks; • Offshore chemical use and discharge, and offshore oil discharges will be risk assessed and permitted under the Offshore Chemicals Regulations 2002 (OCR) and the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended) (OPPC) respectively; • A waste materials inventory will be prepared in advance of the works to inform waste management planning; • All waste management sites and waste carriers used will hold appropriate environmental and operating licences; and • Spirit Energy's management of change process will be followed should there be a change to the proposed scope.
Seabed disturbance
• All activities which may lead to seabed disturbance will be planned, managed and implemented in such a way that disturbance is minimised; • Careful planning, selection of equipment, and management and implementation of activities; • A debris survey will be undertaken at the completion of the decommissioning activities. Any debris identified as resulting from decommissioning activities will be recovered from the seabed where possible; and • Optimise the area that requires an overtrawl assessment and explore the possible use of sidescan sonar instead of fishing gear, through discussion with the relevant fishing organisations and the regulator.
Large Releases to Sea
• Releases, including potential large hydrocarbon releases, will be managed under the existing OPEP. The OPEP will be updated with details of any additional hydrocarbon inventory brought in to the field by the decommissioning activities; • All vessel activities will be planned, managed and implemented in such a way that vessel durations in the field are minimised; and • Spirit Energy's existing marine procedures will be adhered to, to minimise risk of hydrocarbon releases.

Table 1.4.1: Summary of control and mitigation measures

2. INTRODUCTION

This Environmental Appraisal (EA) report is a supporting document to the Decommissioning Programmes, required by the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), for the proposed decommissioning of the Drilling Platform 3 (DP3) and Drilling Platform 4 (DP4) installations and associated pipelines and cables, in the South Morecambe Field.

The purpose of the EA is to assess the environmental and socio-economic impacts and potential impacts (risks) associated with decommissioning, and to identify control and mitigation measures to reduce the level of these impacts to ‘as low as reasonably practicable’.

This EA should be read in conjunction with the DP3-DP4 Decommissioning Programmes document [96] which contains detailed information about DP3 and DP4 installations and associated infrastructure and proposed decommissioning solutions and activities.

At CPP1 and DP8 the pipeline and cable ends will be decommissioned at the same time as the respective installations.

2.1 Project background and purpose

DP3 and DP4 are in the east Irish Sea (EIS), United Kingdom Continental Shelf (UKCS) Blocks 110/8a and 110/3a respectively. They produced gas, and small quantities of condensate and produced water from the South Morecambe Field, and are located approximately 30km due west of Blackpool in water depths of 22-25m Lowest Astronomical Tide (LAT). The nearest jurisdictional boundary is the UK/Ireland median line located approximately 115km to the west. The territorial waters of Isle of Man (IoM), a British Crown Dependency, are located 42km to the northwest (of DP4) (Figure 2.1.1).

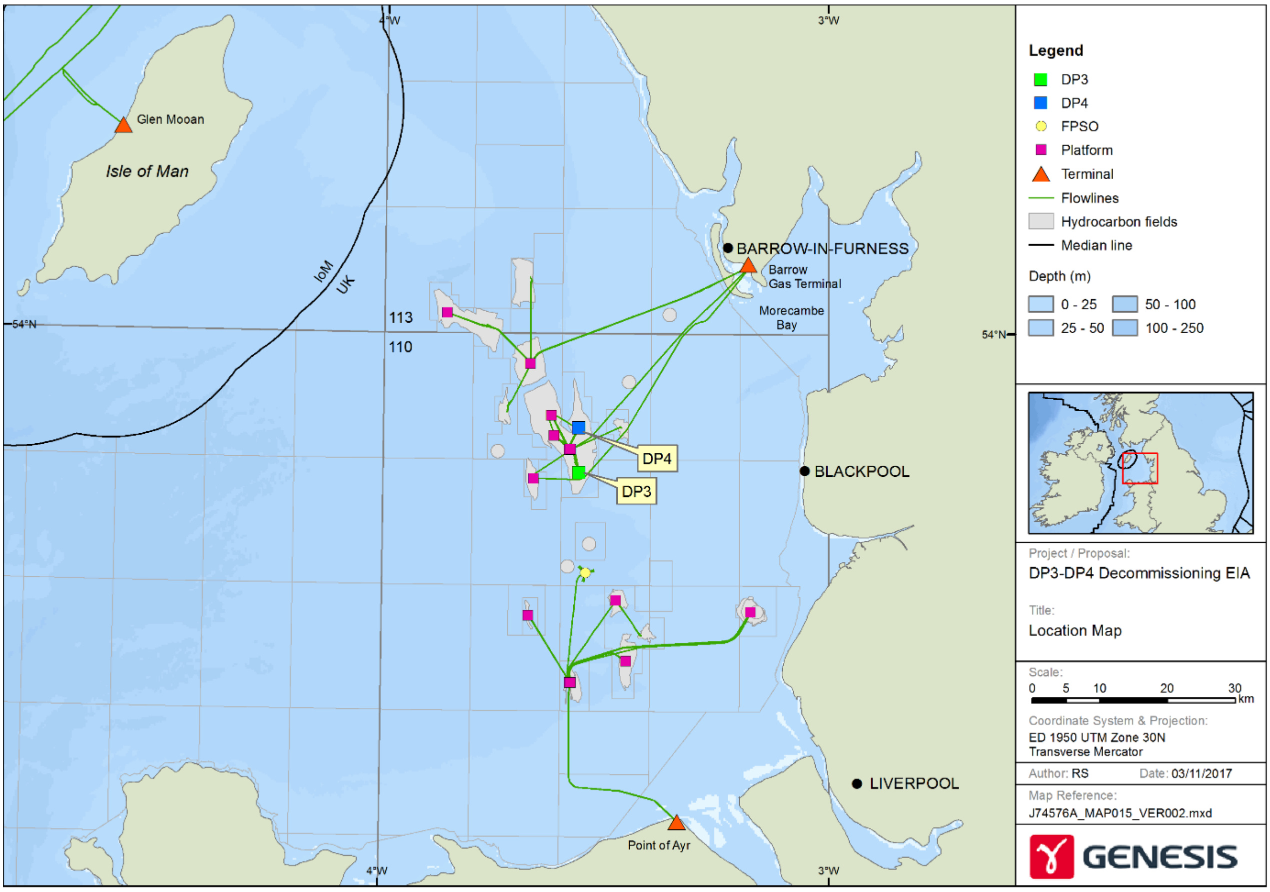

Figure 2.1.1: Location of the South Morecambe Field in the EIS

DP3 and DP4 were installed in 1983 and 1984 respectively and were tied back to the Central Production Complex (CPC) as part of the South Morecambe Stage 1 Field Development. DP3 and DP4 are classified as normally unattended installations (NUIs), as are the DP6, DP8 and Calder platforms which are also tied back to the CPC (Figure 2.1.2). The field achieved first production in 1985. DP3 and DP4 are owned and operated by Spirit Energy Production UK Limited (hereafter referred to as Spirit Energy).

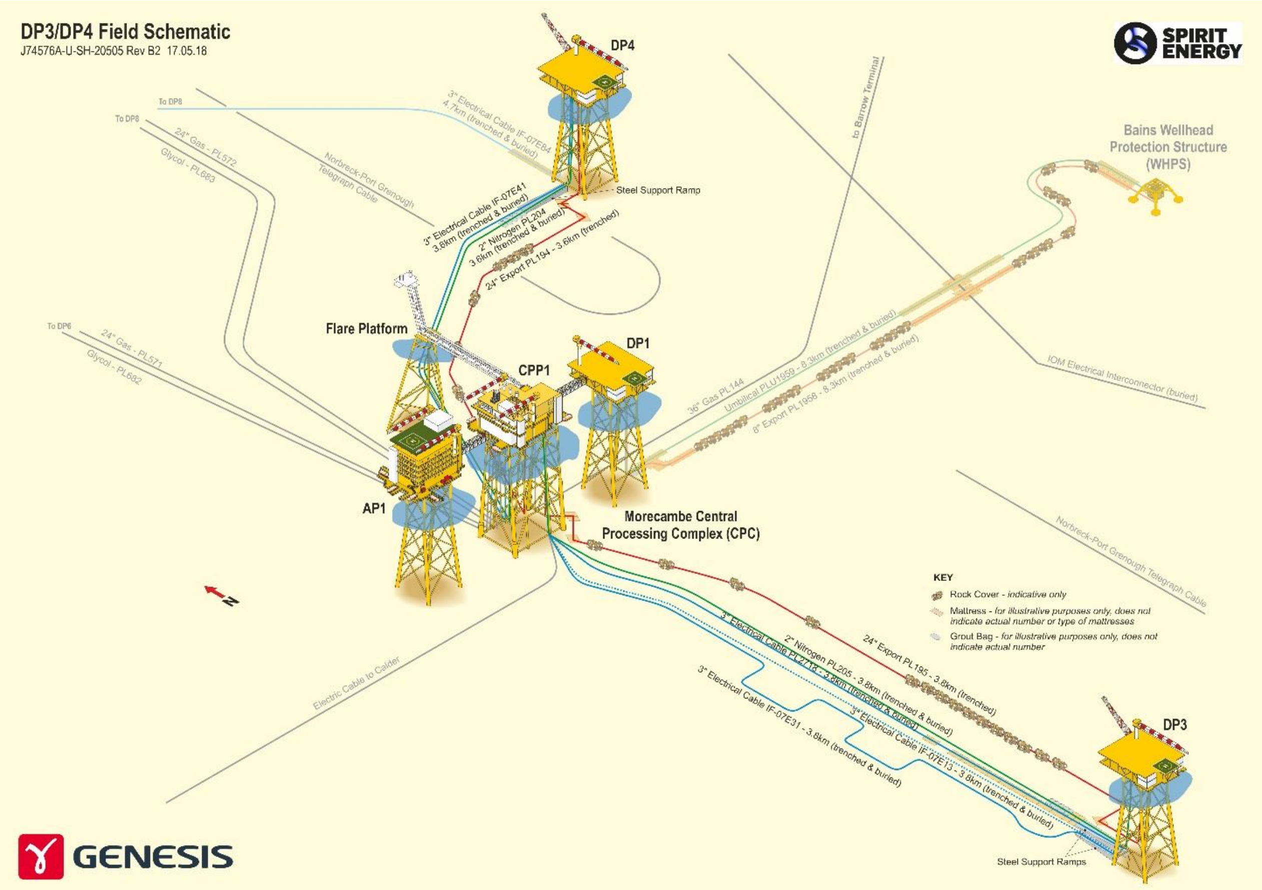

Figure 2.1.2: DP3 and DP4 infrastructure

DP3 and DP4 are similar six-well drilling platforms, each with an individual four-leg steel jacket structure supporting wells, basic processing facilities and a utilities module, as illustrated schematically (for DP3) in Figure 2.1.3. The principal differences are supporting jacket height (due to water depths being approximately 22m and 25m LAT at DP3 and DP4 respectively), and DP4 having eight skirt piles; DP3 has twelve. Each platform features 16 conductor slots and six vertical or slanted wells.

DP3 exports production to the Central Processing Platform (CPP1), approximately 3.5km to the northwest, via a 24” concrete-coated gas pipeline (PL195). Chemicals are supplied from CPP1 using a 2” monoethylene glycol (MEG) (latterly nitrogen) line (PL205) and power and controls were supplied using an electric and fibre-optic cable (PL2718). Two redundant electric cables, IF-07E13 and IF-07E31, remain installed, the latter having had its ends removed to make way for PL2718. All these pipelines and cables are trenched and buried. The gas export pipeline is covered in deposited rock for approximately 200m at the approaches to both DP3 and CPP1 (Figure 2.1.2).

Similarly, DP4 exports production to the CPP1 platform, approximately 3.6km to the southwest, via a 24” concrete-coated gas pipeline (PL194). Chemicals and power are supplied from CPP1 using a 2” monoethylene glycol (MEG) (latterly nitrogen) line (PL204) and cable IF-07E41 respectively. An additional electric and fibre-optic cable (IF-07E84) connects DP4 to DP8. All these pipelines and cables are trenched and buried. The gas export pipeline is covered in deposited rock for approximately 200m at the approaches to both DP4 and CPP1 (Figure 2.1.2).

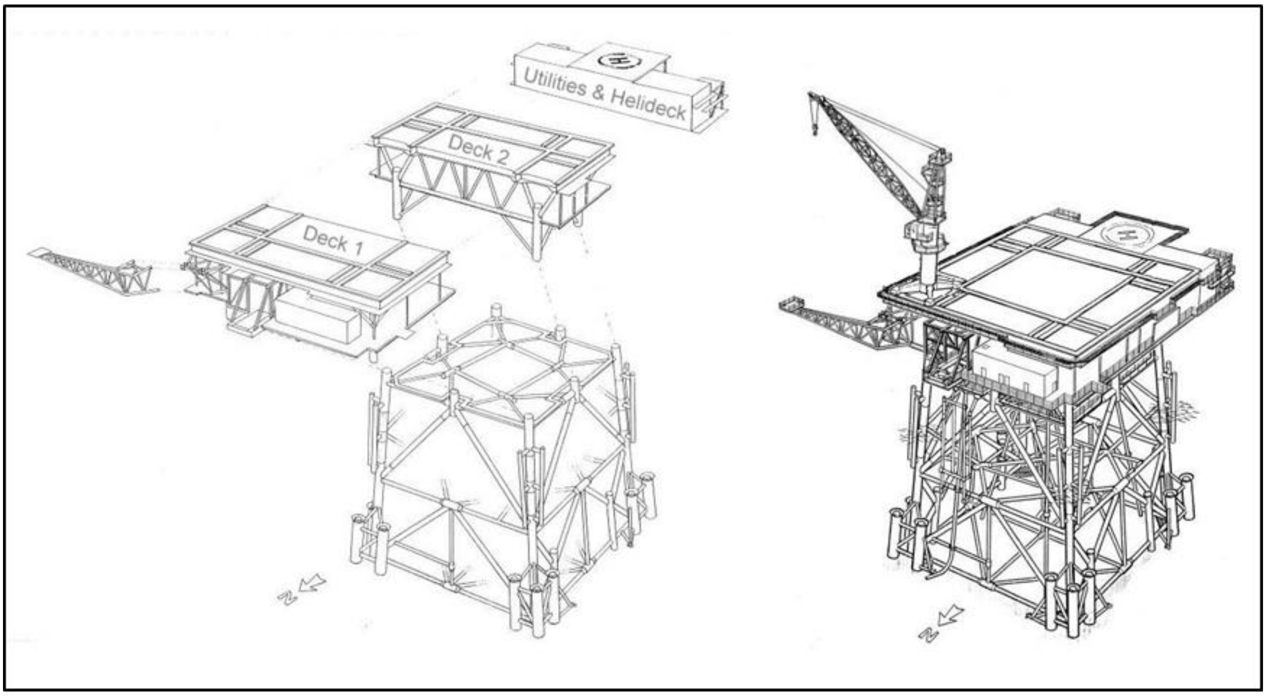

Figure 2.1.3: DP3 construction schematic (DP4 similar)

Decommissioning of DP3 and DP4 will reduce the maintenance of integrity burden and the safety risk across the Morecambe Hub. Analysis shows the South Morecambe Field reservoirs are connected and remaining reserves will be recovered through other wells in the field. Decommissioning of DP3 and DP4 is considered key to reducing operating costs and therefore maximising field life.

2.2 Regulatory context

The decommissioning of offshore oil and gas infrastructure (including pipelines) 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 OPRED before the owners of an offshore installation or pipeline may proceed with decommissioning.

There is no statutory requirement to undertake an Environmental Impact Assessment (EIA), but OPRED decommissioning guidance [6] advises that any Decommissioning Programme be supported by an assessment of the environmental impacts and risks of undertaking decommissioning activities. This EA is intended to meet this requirement.

The UK's international obligations on decommissioning are governed principally by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention). OSPAR Decision 98/3 requires that all installations should be completely removed and recovered to shore for re-use, recycling or final disposal unless a derogation is granted. Pipelines and cables are not included within the Decision, however OPRED decommissioning guidance requires that operators aim to achieve a clear seabed and robustly assess decommissioning options, based on evidence and data, using the Comparative Assessment (CA) process.

In accordance with OPRED decommissioning guidance, this EA does not repeat information that is presented in the Decommissioning Programmes except where necessary.

2.3 Stakeholder consultation

Stakeholder engagement is important throughout the decommissioning process. Informal responses received to date from stakeholders have been incorporated into the DP3 and DP4 Decommissioning Programmes. Formal stakeholder consultation will begin with the submission of the draft Decommissioning Programmes, supported by this EA report, to OPRED. The consultation process, at this stage, will include the use of the Spirit Energy website to make these documents publicly available.

2.4 Business Management System including environmental management

Spirit Energy manages environmental impacts and risks using an International Standardisation Organisation (ISO) 14001-certified Environmental Management System (EMS). Decommissioning of DP3 and DP4 will be managed in accordance with the Spirit Energy EMS.

2.4.1 Contractor management

Contractor management is one of the primary mechanisms Spirit Energy uses to manage environmental impacts and risks, and a project management team will be appointed to select and manage the operations of competent contractors. The team will ensure the decommissioning is executed safely, in accordance with Spirit Energy's Health and Safety Principles and safeguard the environment in line with the environmental policy. Any change to the proposed decommissioning activities will be discussed with OPRED.

3. ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

Activities are first reviewed to identify planned and unplanned interactions with the environment (aspects). Using baseline environmental information to identify receptors, the environmental and socio-economic impact of planned aspects are then assessed using the method described in Spirit Energy's Guidance for Environmental Management in Capital Projects [93]. This evaluates the impacts (on a scale of 'low' to 'high' significance) as a function of their extent and duration (recovery time) given the application of industry standard control and mitigation measures. The impact assessment matrix used can be found in Appendix B.

The hierarchy of control and mitigation measures is to preferentially avoid, then minimise, then restore and finally offset adverse impacts to reduce them to a level that is 'as low as reasonably practicable' in line with Spirit Energy's Environmental Policy.

The environmental and socio-economic risk (of impact) from unplanned (accidental) aspects follows a similar process. Following assessment of the potential impact, the risk of impact is evaluated by factoring in the likelihood of the aspect and impact occurring using the Spirit Energy E&P HSES Risk Assessment Matrix [94] (Appendix B).

Aspects with impacts or risks which have been categorised as of 'low' significance are not subject to further assessment (Section 5). Aspects with impacts or risks which have been categorised as of 'medium' or 'high' significance are assessed in more detail, with additional control and mitigation measures being considered (Section 7).

The process is represented diagrammatically in Figure 2.4.1.

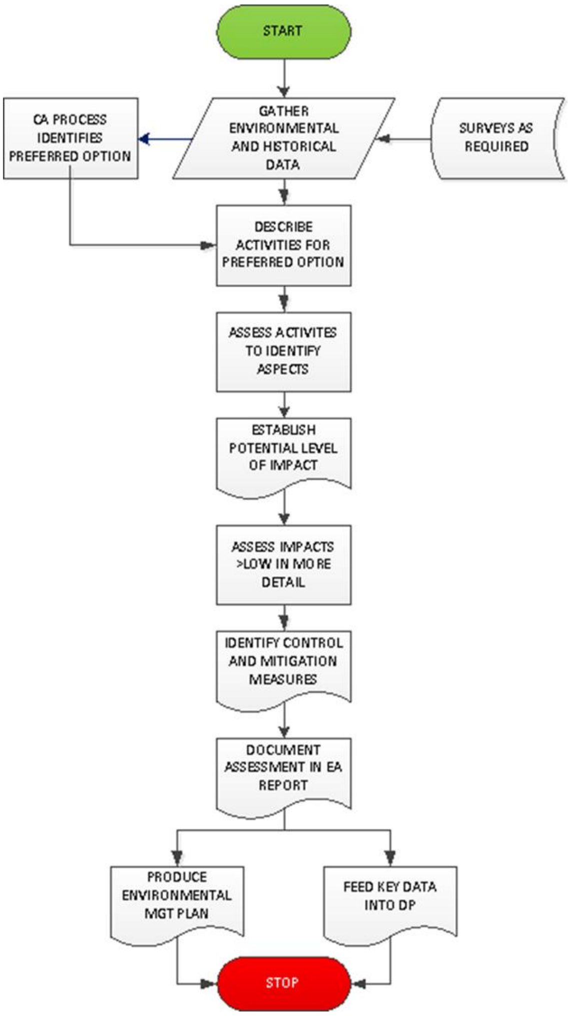

Figure 2.4.1: EIA Process

4. PROJECT DESCRIPTION

This section summarises the selected decommissioning solution for DP3 and DP4 installations and associated infrastructure and outlines the methods that will be used.

The selected decommissioning solutions involve complete decommissioning of the DP3 and DP4 installations (Section 4.2). Associated pipelines and cables will be decommissioned *in situ* where they are buried and stable (Section 4.3). At CPP1 and DP8 the pipeline and cable ends will be decommissioned at the same time as the respective installations. Additional project information is available from the DP3-DP4 Decommissioning Programmes document [96].

Infrastructure that will be decommissioned within the scope of the Decommissioning Programmes is illustrated in Figure 4.1.1.

At the time of preparing this EA, detailed engineering to define the decommissioning methods has not been carried out. The EA is based on common industry methods for the proposed decommissioning activities. Where more than one method could be used, the one that presents the worst case potential environmental impact has been assessed.

Preparatory works, which are outside the scope of this EA, are briefly described to better inform the assessment of environmental and socio-economic impacts and risks.

Surveys and vessel activities associated with offshore decommissioning are described in Sections 4.4 and 4.5 respectively.

4.1 Preparatory works

4.1.1 Well decommissioning

Twelve wells (six at DP3 and six at DP4) will be decommissioned in compliance with Health and Safety Executive (HSE) regulations (HSE, 1996) and with Oil and Gas UK (OGUK) guidelines [73] prior to platform decommissioning. Decommissioning operations at each platform will require the use of a 'slant' rig supported by a jack-up work barge. The spud cans used to stabilise the JUWB will result in local seabed disturbance.

Environmental impacts associated with well decommissioning, including chemical use and discharge, possible oil discharges, jack-up rig seabed impacts and risk to navigation, will be assessed through well decommissioning permits and consents submissions, and are therefore not considered further here.

4.1.2 Pipeline preparation

The pipelines connecting DP3 and DP4 to the Central Processing Complex (CPP) will be prepared for decommissioning, most likely using a combination of pigging and flushing. The exact cleaning method will be developed during detailed engineering design and agreed with OPRED through the environmental permitting process and associated consultation. The impacts associated with pipeline preparation are, therefore, not considered further here.

4.1.3 Topsides preparation

The topsides process system of each platform will initially be vented and purged with nitrogen. Process vessels, pipework and drains will then be cleaned (flushed) with seawater before their removal. Any effluent will be contained and shipped to shore for appropriate disposal. The impacts associated with topsides preparation are, therefore, not considered further here.

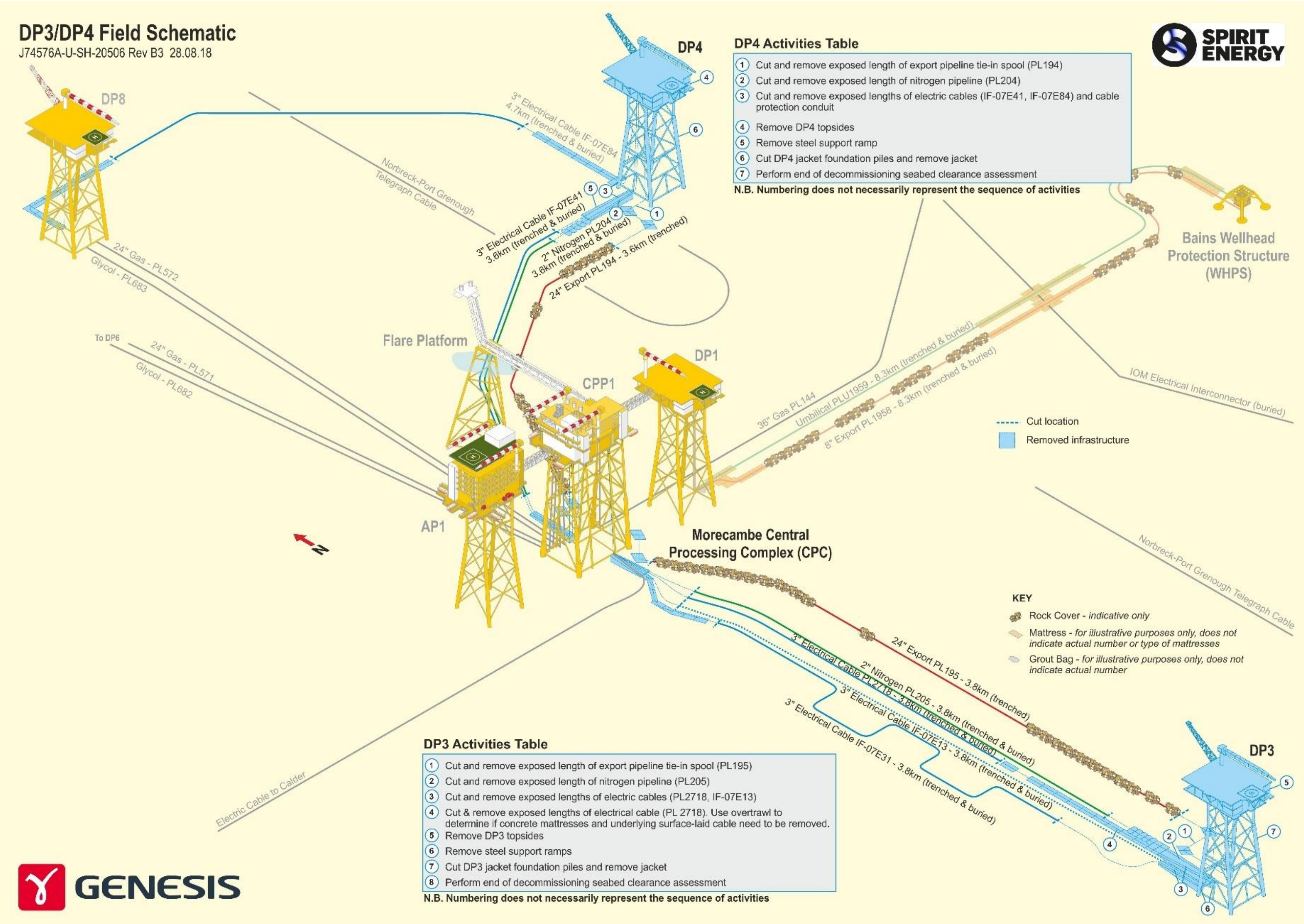

Figure 4.1.1: Infrastructure to be decommissioned

4.2 Platform decommissioning

DP3 and DP4, including their topsides and jackets, will be completely removed using specialist tools and lifting apparatus deployed from a surface vessel, and recovered to shore for preferential re-use or recycling of their component materials in accordance with the principles of the Waste Hierarchy. Table 4.2.1 summarises the proposed platforms' decommissioning solutions and activities within the scope of this EA.

PROPOSED DECOMMISSIONING SOLUTION	OPTIONS AND METHODS
Topsides	
Complete removal and recycling. The topsides will be removed and transported to shore and recycled unless alternative options are meantime found to be viable and more appropriate. Any environmental permit applications required for work associated with removal of the topsides (Master Application Templates (MATs) and supporting Subsidiary Application Templates (SATs)) will be submitted.	Topsides removal options include: • Removal of topsides and jackets as a complete unit; • Removal of topsides as single units (preferred); and • Removal of topsides in a series of smaller sub-units. The preferred option is removal of topsides separately from the jackets followed by recovery to shore for preferential re-use, then recycling, and finally disposal as appropriate. A final decision on the removal method will be made following a commercial tendering process. As a worst case, the EA (Section 7.1) assumes a HLV with up to 12 anchors will be used to recover the two topsides.
Jackets	
Complete removal and recycling. The leg piles will be cut 1m below seabed and the jacket will be removed and transported to shore for recycling; Any permit applications required for work associated with removal of the jackets (MATs and SATs) will be submitted.	Jacket removal options include: • Removal of topsides and jackets as a complete unit; and • Removal of jackets as single units (preferred). The preferred option is to lift and remove the jackets from the seabed as a single unit using specialist tools and lifting apparatus deployed from a surface HLV and recover to shore. A final decision on the removal method will be made following a commercial tendering process. However, as a worst case, the EA (Section 7.1) assumes a HLV with up to 12 anchors will be used to recover the two jackets. The sediments 1m below the seabed comprise stiff clay. From a technical perspective, it would not be possible using reasonable endeavours to cut the piles 3m below seabed using internal cutting equipment. Therefore, given the layout of the leg and skirt piles, in order to minimise disturbance to the seabed the piles will be cut internally 1m below the seabed, enabling the jacket to be removed in a single lift. If any difficulties are encountered in accessing the piles, such as necessitating external excavation and cutting, OPRED will be consulted before the piles are cut. The jacket will be recovered to shore for recycling. Similarly, the three anti-scour support ramps which are hooked over the jacket bottom braces (two at DP3 and one at DP4) with the ends resting on mattresses will be removed and recovered to shore.

Table 4.2.1: Proposed platform decommissioning solutions [96]

4.3 Pipeline decommissioning

As discussed in Section 2.2, pipelines and cables are not part of OSPAR Decision 98/3. However, OPRED decommissioning guidance requires that operators aim to achieve a clear seabed and robustly assess decommissioning options, based on evidence and data. A CA [97] of the DP3 and DP4 pipeline decommissioning options has been completed using the BEIS Decommissioning Guidance Notes [6] and Spirit Energy's Comparative Assessment Guidelines.

4.3.1 Proposed decommissioning solution

Table 4.3.1 summarises the pipeline decommissioning activities within the scope of this EA. Apart from at the platform approaches, all the pipelines and cables have been found to be buried to a depth greater than 0.6m below the seabed. Figure 4.3.1 and Figure 4.3.2 illustrate the pipeline and cable approaches at DP3 and DP4 including protection and stabilisation features. Equivalent illustrations at CPP1 and DP8 are included in the Decommissioning Programmes [96].

PROPOSED DECOMMISSIONING SOLUTION	OPTIONS AND METHODS
Pipelines, Flowlines & Umbilicals	
PL194 and PL195 will be flushed and left buried *in situ*. On approach to the DP3, DP4 and CPP1 platforms the exposed pipelines and associated protection and stabilisation features excluding deposited rock will be removed. 29 bitumen mattresses and 66 concrete mattresses are anticipated to be exposed. Any permit applications required for work associated with pipeline pigging, flushing, cutting and removal (MATs and SATs) will be submitted.	Pipelines and cable approaches at DP3, DP4, and CPP1 will be cut (and removed) at a point at which they reach full trench burial depth, approximately 1m below natural seabed. Local excavation of sediment will be required to expose the pipelines and cables and enable access. The remaining pipeline and cable ends will be buried. The relatively high-energy environment will result in any small excavations backfilling naturally. Survey data would suggest that there is no evidence of historic spud can depressions from jack-up rigs at either platform. The rate at which backfill will occur is not known, but remedial work will be undertaken at pipeline and cable ends if post-decommissioning surveys confirm backfill is not sufficient. Where access and their condition safely allows, any exposed pipelines, cables, protection and stabilisation features (including mattresses and grout bags), will be completely removed from the seabed using specialist tools and lifting apparatus deployed from a surface vessel, and recovered to shore. It is estimated that 1.4km of pipelines and cables will be removed in total. The locations of pipeline and cables, approximate cut locations, and associated stabilisation features are summarised in Figure 4.3.1 and Figure 4.3.2. If exposed, the midline mattresses will be completely removed from the seabed using specialist tools and lifting apparatus deployed from a surface vessel and recovered to shore. Following this, should it be considered that the cable would present a snagging hazard prior to the verification overtrawl, as a contingency measure the cable may either need to be retrenched and buried or small quantity of deposited rock (up to 15Te) may be required to protect the cable.
PL204 and PL205 will be flushed and left buried *in situ*. On approach to the DP3, DP4 and CPP1 platforms the exposed pipeline ends, and associated protection and stabilisation features will be removed. Any permit applications required for work associated with pipeline pigging, flushing, cutting and removal (MATs and SATs) will be submitted.	
Two redundant power cables IF-07E13 and IF-07E31; the power and fibre-optic cable PL2718; redundant power cable IF-07E41 and power and fibre-optic cable IF-07E84 will be left buried *in situ*. Unless exposed the five midline mattresses on PL2718 will be left *in situ* (Figure 4.3.3).	

Table 4.3.1: Proposed pipeline and cable decommissioning solutions [96]

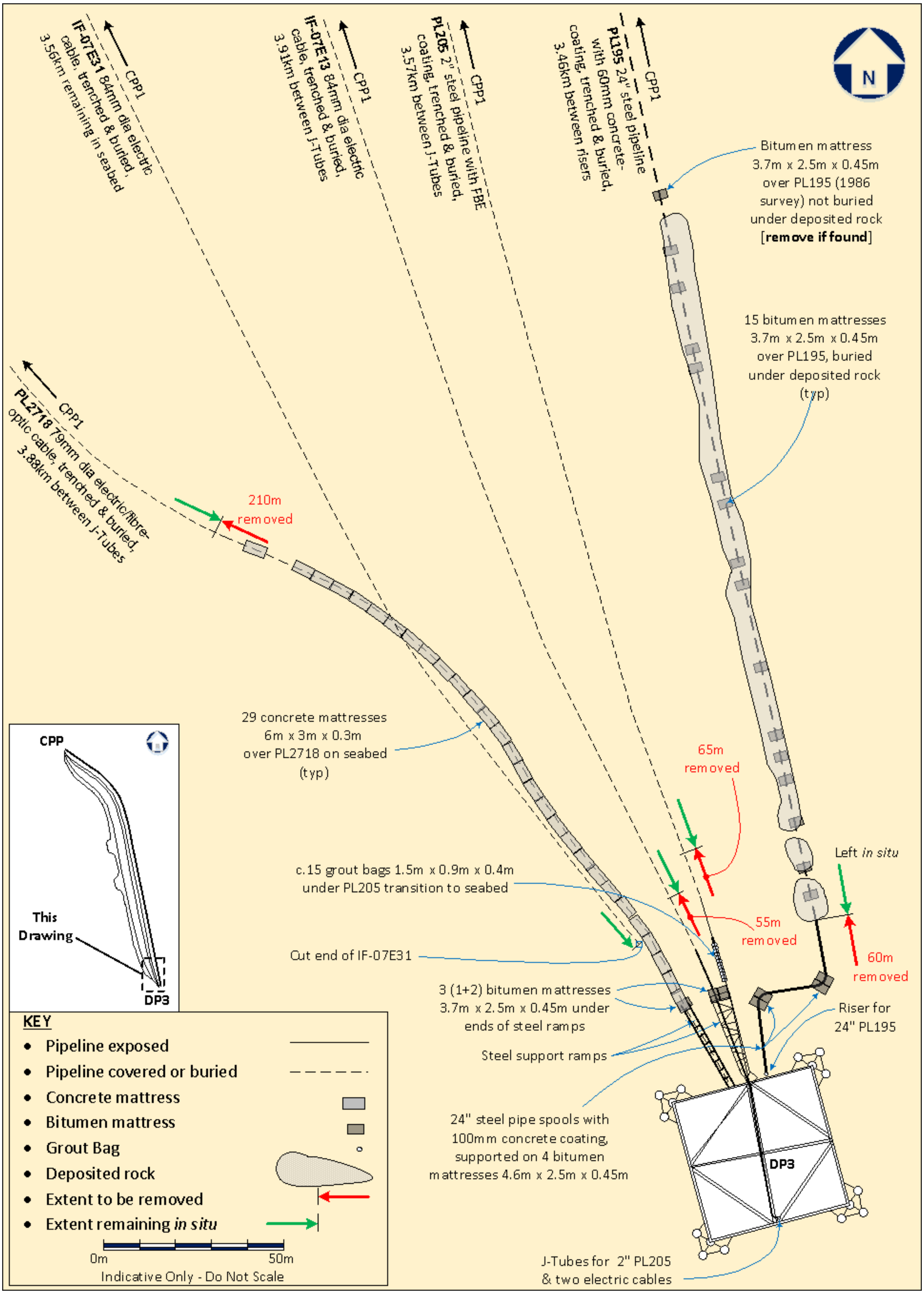

Figure 4.3.1: DP3 pipeline disconnections and stabilisation features [96]

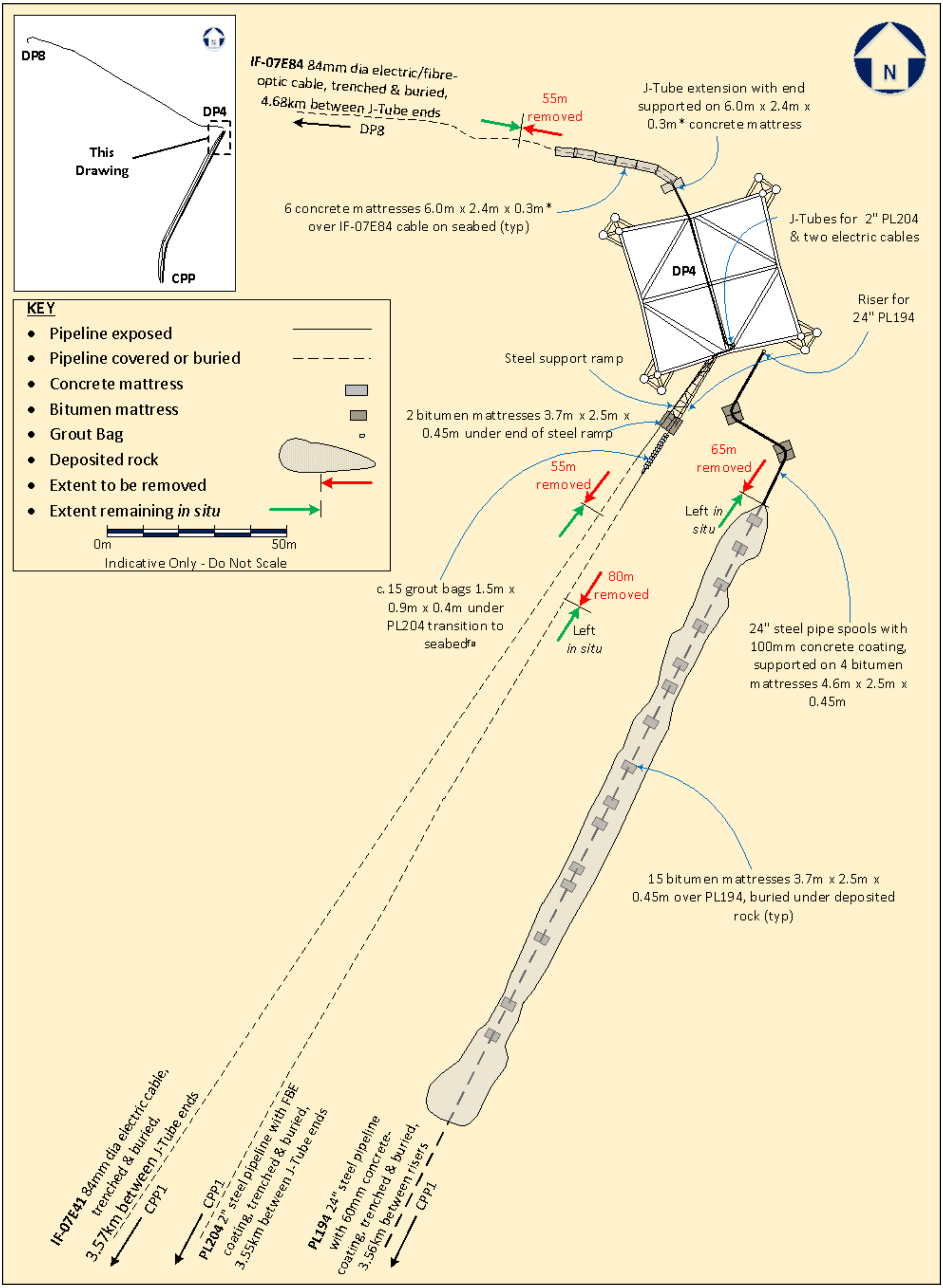

Figure 4.3.2: DP4 pipeline disconnections and stabilisation features [96]

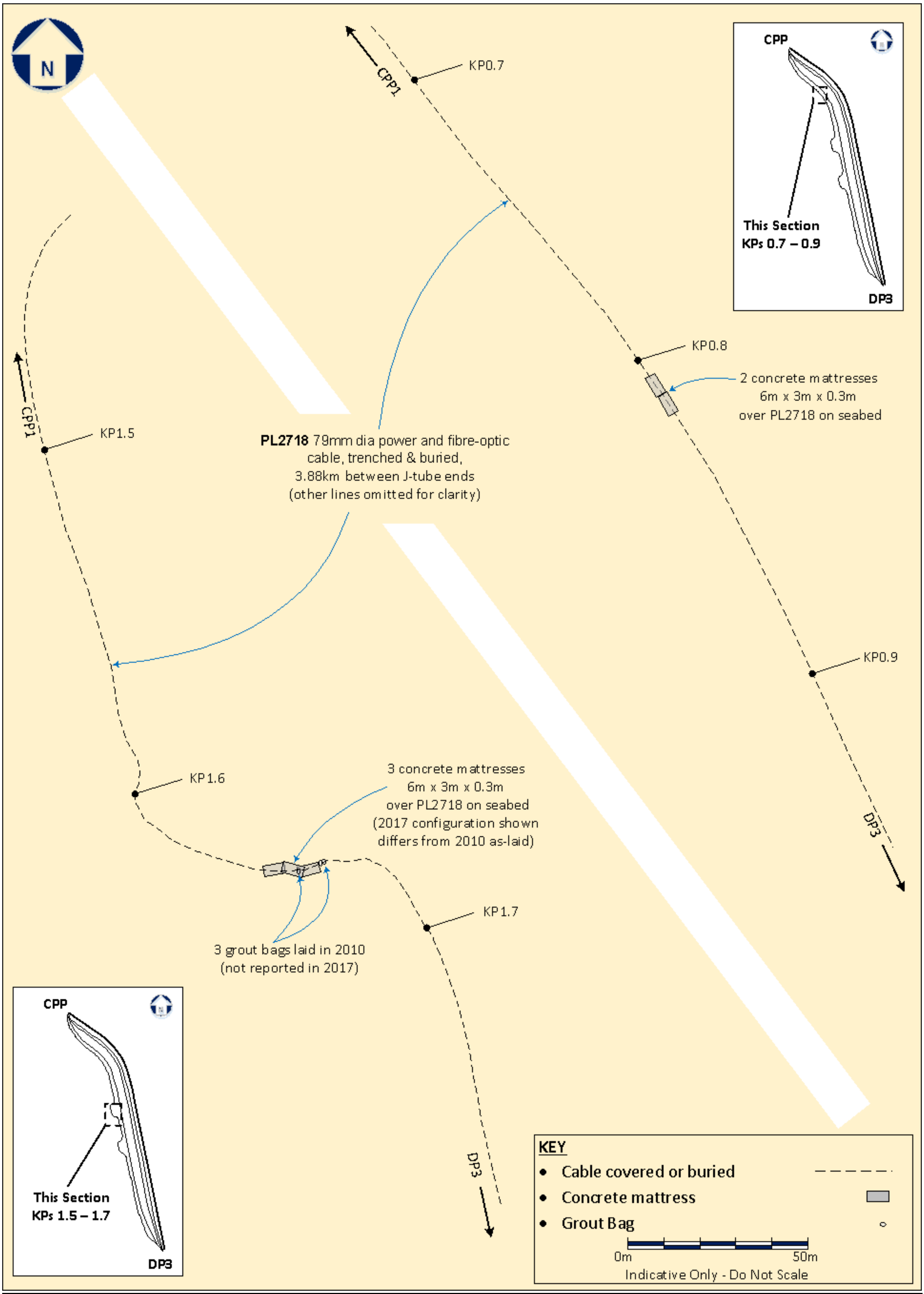

Figure 4.3.3: PL2718 midline mattresses

Exposed bitumen and concrete mattresses, and grout bags, will be removed and recovered as described in Table 4.3.2.

ITEM	DETAILS	BURIAL STATUS	PROPOSED DECOMMISSIONING SOLUTION
Bitumen mattresses	17 Type 1: 4.62 x 2.46 x 0.45m; 77 Type 2: 3.69 x 2.46 x 0.45m.	Exposed / buried under deposited rock.	65 mattresses are buried under rock and will not be removed. 29 exposed mattresses will be lifted and removed from the seabed using grappling tools deployed from a surface vessel and recovered to shore.
Concrete mattresses	48 Type 1: 6 x 3 x 0.3m; 23 Type 2: 6 x 2.4 x 0.3m.	Exposed / partly exposed.	Of these 71 mattresses, five are partly buried on PL2718 (Figure 4.3.3), however Spirit Energy are proposing to recover all 71 of these mattresses using grappling tools deployed from a surface vessel and recovered to shore. Local excavation may be required to allow access for removal.
Grout bags	162 (indicative).	Exposed.	An indicative 162 exposed grout bags will be lifted and removed from the seabed using grappling tools deployed from a surface vessel and recovered to shore. Local excavation may be required to allow access for removal. No exposed grout bags will be decommissioned *in situ*.
Existing rock cover	PL195 approach to DP3 (approximately 200m). PL195 approach to CPP1 (approximately 200m). PL194 approach to DP4 (approximately 200m). PL194 approach to CPp1 (approximately 200m).	Largely exposed.	Decommissioned *in situ*.
Small granular rock (19mm to 90mm)	An estimated maximum of 15Te for each area of rock cover. 75Te in total.	N/A	Small granular rock may be used for contingency purposes as follows: • To ensure the edges of bitumen mattresses within the existing footprint of deposited rock will remain buried (4 x locations); • To ensure that the cut pipeline and cable ends will remain buried; • To ensure that PL2718 will remain buried should the concrete mattresses be removed. Using engineering judgement in each case an estimated that up to 15Te of rock may be required for the remedial works. Up to 15Te for each 200m stretch of deposited rock and up to a total of 15Te for the mid-line mattresses, remembering that these are situated in two locations (Figure 4.3.3).

Table 4.3.2: Proposed solutions for decommissioning protection and stabilisation features

4.4 Surveys

A series of surveys will be required to be undertaken before, during, and after the decommissioning project execution phase. These are summarised in Table 4.4.1.

4.4.1 Pre-decommissioning survey

A pre-decommissioning environmental survey will be undertaken in advance of execution phase activities to inform decommissioning plans; environmental permit applications; and provide a baseline against which to reference the results of any post-decommissioning environmental surveys. The environmental survey data will be used in the planning of any legacy surveys.

4.4.2 Execute phase and legacy surveys

When all infrastructure and materials have been either removed, or decommissioned *in situ*, a series of surveys will be undertaken:

- The Dive Support Vessel (DSV) or Construction Support Vessel (CSV) will undertake a seabed debris survey before leaving the field and any debris identified will be recovered from the seabed where possible;
- At a time after any debris has been removed, a seabed clearance survey will be completed. This will be either a seabed overtrawl assessment undertaken by a fishing vessel, or a sidescan sonar (SSS) survey using a survey vessel, following consultation and agreement with the National Federation of Fishermen's Organisations (NFFO) and the Regulator. When this assessment has been completed to its satisfaction, the NFFO will issue a Clear Seabed Certificate; and
- Environmental surveys will also be undertaken using a survey vessel.

The results of these surveys will identify any changes to the seabed following infrastructure decommissioning, will feed into the project close-out report, and will inform the requirements for possible future legacy environmental surveys.

Table 4.4.1 summarises the anticipated decommissioning survey requirements. The timing and extent of required legacy surveys will be agreed in conjunction with OPRED.

PHASE	SURVEY	REQUIREMENT
Preparation for decommissioning activities	**Pre-decommissioning environmental survey** (survey vessel deploying grab sampling equipment, drop-down camera and video, SSS and multibeam echosounder (MBES)	Feeds into decommissioning plans.
Execute Phase Decommissioning	**Visual debris survey** (DSV or (CSV deploying a Remotely Operated Vehicle (ROV)) **Overtrawl or SSS assessment** to verify absence of snagging hazards (fishing vessel deploying bottom trawling equipment, or a survey vessel using remote sensing technology)	Obtain Clear Seabed Certificate. Feeds into project close-out report.
	Post-decommissioning environmental survey	Feeds into close-out report and informs requirements for future surveys.
Future	**Legacy environmental survey(s)**	Timing and extent dependent on outcome of earlier surveys.

Table 4.4.1: Survey requirements

4.5 Vessel use

A range of specialist and support vessel types will be required at various times, and for various durations, to undertake the decommissioning activities. Each, in conjunction with the chosen offshore contractor, will be confirmed during the project's detailed design and execution phase. Offshore vessel use will take place primarily at DP3 and DP4, with transits between ports and these locations. The presence of such vessels will introduce additional navigation risk, new chemical and hydrocarbon inventories, atmospheric emissions and sources of underwater sound to the area.

Vessel fuel inventory, fuel consumption and associated atmospheric emissions, and seabed disturbance because of vessel activities will depend on the vessels selected and the duration of activities.

4.5.1 Infrastructure decommissioning

Pipeline and cable cutting, and some debris clearance, will be executed by a DSV or CSV, prior to recovery of the DP3 and DP4 installations. This vessel will deploy remotely operated vehicles (ROVs), divers, and specialist subsea tools in the execution of these activities.

A HLV will be used to lift and recover the DP3 and DP4 topsides and jackets. The type of HLV has not yet been determined. Options include a semi-submersible crane vessel (SSCV) or a monohull crane vessel (MCV).

The largest fuel inventory, fuel consumption and emissions, will be associated with the HLV. The worst case is use of a large SSCV to lift the DP3 and DP4 topsides and jackets separately. These will be transported to shore separately using cargo barges and tugs. A SSCV could potentially maintain its position using dynamic positioning, but for the purposes of this assessment it is assumed that, because of the relatively shallow water depth at DP3 and DP4, the HLV will be stationed using anchors deployed by Anchor Handling Tugs (AHTs). The worst-case seabed disturbance would result from the positioning of the HLV using anchors in two locations at each platform.

4.5.2 Survey

Surveys will be undertaken by specialist vessels as described in Section 4.4.2. A suitable survey vessel will complete the environmental surveys, using remote sensing technologies likely to include sidescan and multibeam sonar, and a magnetometer. Seabed grab sampling equipment and drop-down camera and video, will also be deployed from the environmental survey vessel to determine the physico-chemical and biological status of the seabed.

It is likely that the overtrawl assessment will be completed by a suitable fishing vessel using towed demersal fishing gear that is typically used in the area. However, discussions with the relevant fishing organisations and the regulator will explore options to minimise seabed disturbance. This could be by optimising (minimising) the area that requires an overtrawl assessment using fishing gear, or the use of SSS instead.

4.6 Management of waste and recovered materials

Recovered materials will be transported to a shore base for initial laydown. There they will undergo light processing (cleaning, cutting, crushing etc. but excluding recycling) by a variety of plant and equipment in preparation for their preferential re-use, recycling, or as a last resort, disposal to landfill at an appropriate licenced site.

Non-hazardous material includes scrap metals (steel, aluminium and copper), concrete and plastics that are not contaminated with hazardous material. Hazardous waste is expected to include hydrocarbon or chemical residues, radioactive material, and small amounts of asbestos.

An estimate of the quantities of materials that comprise the DP3 and DP4 installations; pipelines, cables and associated protection and stabilisation features (excluding rock cover) is provided in Table 4.6.1. Section 5.6 discusses the generic types of materials that will be recovered, represented using pie charts, and the management of waste streams.

ITEM / FEATURE	INVENTORY (Te)				
	TOTAL	STEEL	PLASTIC	NON-FERROUS METALS	CONCRETE/ GROUT/SAND
INSTALLATIONS					
DP3 Total	11,924	11,531	9	242	142
DP3 Recovered	10,112	9,820	9	242	42
DP3 Decommissioned *in situ*	1,812	1,711	0	0	100
DP4 Total	11,344	10,990	7	215	132
DP4 Recovered	9,956	9,691	7	215	43
DP4 Decommissioned *in situ*	1,388	1,299	0	0	89
Total DP3 & DP4	23,268	22,521	16	457	274
Total DP3 & DP4 Recovered	20,068	19,511	16	457	84
Total DP3 & DP4 Decommissioned *in situ*	3,200	3,010	0	0	190
PIPELINES, CABLES, PROTECTION AND STABILISATION FEATURES					
DP3 Total	4,645	1,108	161	9	3,366
DP3 Recovered	513	39	29	0	445
DP3 Decommissioned *in situ*	4,132	1,070	132	9	2,921
DP4 Total	4,406	1,131	139	2	3,135
DP4 Recovered	582	42	31	0	509
DP4 Decommissioned *in situ*	3,824	1,089	108	2	2,626
Total DP3 & DP4	9,051	2,239	300	11	6,501
Total DP3 & DP4 Recovered	1,095	81	60	0	954
Total DP3 & DP4 Decommissioned *in situ*	7,956	2,158	240	11	5,548
ALL MATERIALS					
All Materials	**32,319**	**24,760**	**316**	**468**	**6,775**
All Materials Recovered	**21,162**	**19,591**	**76**	**457**	**1,038**
All Materials Decommissioned *in situ*	**11,157**	**5,169**	**240**	**11**	**5,737**

Table 4.6.1: DP3 and DP4 materials inventory summary

4.7 Decommissioning schedule

The proposed schedule for DP3 and DP4 decommissioning is shown in Figure 4.7.1. This is indicative and subject to change.

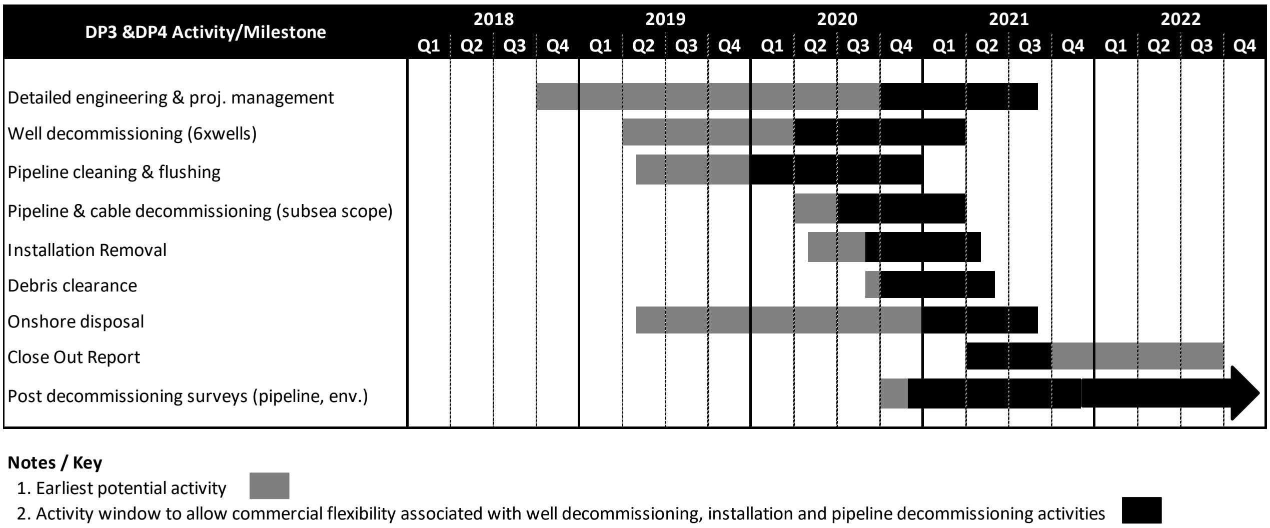

Figure 4.7.1: DP3 and DP4 decommissioning schedule [96]

5. INITIAL ENVIRONMENTAL ASSESSMENT

Environmental Assessment and Management Workshops were held on the 26th September 2017 and 29th August 2018, during which project aspects were identified and the associated environmental impacts and risks were assessed using Spirit Energy's impact and risk assessment matrices (Appendix B). The outcome of these initial assessments is presented in Table 4.7.1.

Aspects that were categorised as having positive impacts, or negative impacts of **low** significance, were not selected for detailed assessment and are discussed briefly below (Sections 5.1 to 5.6). Aspects that were categorised as having potential impacts of 'medium' significance, are selected for further assessment and are discussed in detail in Section 7.

ACTIVITY	ASPECT	RECEPTORS: Physical				Biological						Socio-Economic							Comments
		Resource Use	Air quality	Water quality	Sediment Quality	Plankton	Benthic communities	Fish	Marine mammals	Seabirds	Protected Habitats	Fisheries	Shipping	Landfill resources	Other sea users	Local communities	Cumulative	Transboundary	
Vessel presence at DP3 and DP4 Vessel transits Materials processing at shore base	Physical Presence								L	L		L (P)	L (P)			L(P)	L (P)		Section 5.1
Vessel fuel use Onshore transport and processing of recovered materials (including steel recycling) Use of steel for topsides module reinforcement prior to lifting Manufacture of equivalent steel to piles, pipeline and cables decommissioned *in situ*	Resource Use	L (P)															L	L	Section 5.2
	Energy and Atmospheric Emissions		L														L	L	Section 5.3
Vessel activities (engines and propulsion, machinery) Cutting of piles, pipelines and other infrastructure Use of acoustic surveying equipment	Underwater Sound							L	L								L		Section 5.4
Local seabed excavations and equipment laydown HLV deployment of anchors / spud cans Lifting of infrastructure Seabed 'over-trawlability' assessment Permanent disturbance from infrastructure, protection and stabilisation features decommissioned *in situ*	Seabed Disturbance			L	L		M	L				L					L		Section 7.1
Pipeline and umbilical cutting at the seabed (post cleaning) Topsides cleaning by flushing (if washings not shipped to shore) Operational vessel discharges (ballast, bilge, grey water, vessel drainage) Unplanned release of topsides oil or chemical inventory	Discharges and Releases to Sea			L		L	L	L	L	L	L	L					L	L	Section 5.5
Unforeseen event during operations for example a collision or fire resulting in a loss of fuel inventory (maximum 9,171m^3)	Large Hydrocarbon Releases			L	L	L	L	L	L	M	L	L				L	L	L	Section 7.2
Processing of recovered material Management of grout densitometer radioactive sources Mangement of small quantities of asbestos Disposal of marine growth	Waste Production													L		L		L	Section 5.6

KEY

- P — Positive – Positive or beneficial impact
- L — Low – Impact broadly acceptable and considered 'as low as reasonably practicable'
- M — Medium – Impact is tolerable but to be managed to 'as low as reasonably practicable'
- H — High – Impact intolerable. Controls and measures required to reduce impact to 'as low as reasonably practicable'
- No interaction with receptor

Table 4.7.1: Summary of DP3 and DP4 decommissioning initial environmental assessment

5.1 Physical Presence

The physical presence of project vessels may result in temporary navigational hazards and nuisance to shipping, a temporary restriction of fishing operations, and disturbance to marine mammals and seabirds.

Offshore vessel activities will take place primarily within the DP3 and DP4 500m safety zones, with transits between ports and these locations. When located inside a 500m safety zone, vessels should not have an impact on shipping and navigation. The HLV has yet to be selected, but the vessel could require deployment of up to 12 anchors connected via anchor lines to hold it on location. Anchors could be positioned up to approximately 1,200m from the HLV and will therefore present a snagging hazard to fishing vessels using demersal gears out with the 500m safety zones. However, levels of fishing activity are low around the platforms (Section 6.4.1).

Interactions with other vessels will be managed through existing marine procedures and, where applicable, the consent to locate process. The fishing industry will be informed of relevant vessel activities and locations using the Kingfisher Information Service.

The increase in vessel traffic may cause disturbance and increase the risk of injury to marine mammals through vessel strikes. The evidence for lethal injury from boat collisions to marine mammals suggests that collisions with vessels are very rare [14]. Furthermore, the South Morecambe Field is not an important area for marine mammals, which are present at low densities (Section 6.2.4). Disturbance from vessels has the potential to cause displacement of seabirds from foraging habitat and may cause flying birds to detour from their flight routes. There is potential for migrating birds to be attracted to vessel lighting, such that they become disorientated and collide with the vessel or installation. However, vessel lighting will not add significantly to existing light sources from platforms and the coast. Therefore, any short term behavioural responses associated with the presence to project vessels are not considered significant.

Vessel use will be optimised where possible, and due to the proposed project being located within an established oil and gas area, the increase in vessel traffic is not anticipated to result in a significant change to existing levels.

The presence of DP3 and DP4 materials at the shore base, their transport to, and presence at, subsequent waste management sites, has the potential to increase local traffic and have a visual impact on local communities. All waste management sites and waste carriers will hold appropriate environmental and other operating licences. Under the Environmental Permitting regime (England and Wales) or the Pollution Prevention and Control regime (Scotland) the impacts to air, land, water and to the local community from waste management sites will have already been assessed as acceptable prior to the issuing of permits. Compliance with the relevant waste legislation will be closely managed within contractor assurance processes.

The removal of DP3 and DP4 will have local positive socio-economic impacts, by removing obstructions to shipping and associated navigational risk, and returning two areas of seabed for exploitation by fishing. There will also be a benefit to the local economy for the duration of decommissioning activities. Removal of the jacket structures, which provide vertical relief and hard substrate, will reduce local habitat diversity with a potential associated negative impact on local ecology and biological diversity.

The significance of the impacts from physical presence associated with the removal of infrastructure, use of vessels, and onshore management of materials has been assessed as **low**.

5.1.1 Cumulative and transboundary impacts

In comparison with current levels of shipping (Section 6.4.3), the presence of vessels undertaking decommissioning activities represent a very small, short term increment. Removal of DP3 and DP4 will reduce the presence of infrastructure and associated vessel traffic in the EIS and will have a positive impact. In the unlikely event that DP3 and DP4 materials are recovered to a shore base outside the UK, compliance with the applicable legislation pertaining to air, land, water and to the local community will be closely managed within contractor assurance processes.

The significance of the cumulative impacts of physical presence associated with the removal of infrastructure, use of vessels, and management of materials has been assessed as **low**. No transboundary impacts are therefore anticipated.

5.2 Resource Use

The use of steel to reinforce the DP3 and DP4 topsides ready for lifting is the only significant use of steel. It is estimated that, as a worst case, 500Te of steel will be required to reinforce the topsides at each platform. However, this steel will be recovered back to shore with the topsides for recycling.

It is estimated that the remaining portion of the jacket foundation piles, located in excess of 1m below natural seabed and decommissioned *in situ*, equates to approximately 3,010Te of steel (1,711Te at DP3; 1,299Te at DP4). This steel resource will be permanently lost, and constitutes approximately 13% of the estimated 22,521Te of steel in DP3 and DP4. It is not technically feasible to recover the piles below 1m, as described in Table 4.3.1. The remaining 87% of the steel inventory will be recovered and made available as a resource by recycling.

Most the materials in the DP3 and DP4 pipelines and cables will be left buried *in situ* and will therefore be lost. This equates to approximately 96% of the steel resource in the decommissioned pipelines and cables (Table 5.3.1).

Permanently lost steel resource equates to 0.07% of UK steel production in 2016 (7,635,000Te) [106]. The use of fuel and energy resources, including the energy used to manufacture and recycle steel, is assessed in Section 5.3 below.

The significance of impacts associated with resource use has been assessed as **low**.

5.2.1 Cumulative and transboundary impacts

Steel is an important global commodity. In the context of UK and world steel production, the significance of cumulative impacts associated with resource use has been assessed as **low**. No transboundary impacts are anticipated.

5.3 Energy Use and Atmospheric Emissions

The decommissioning activities' direct and indirect energy requirements will result in the emission of a range of gaseous combustion products, primarily carbon dioxide (CO_2) but including nitrogen oxides (NO_x), nitrogen dioxide (N_2O), sulphur dioxide (SO_2), carbon monoxide (CO), methane (CH_4) and volatile organic compounds (VOCs).

The offshore use of specialist and support vessels has been identified as the only offshore activity that will have a significant direct energy requirement. Decommissioning activities undertaken by the project vessels are summarised in Section 4.

The other significant use of energy will be that indirectly used in recycling recovered materials onshore. New steel, sourced to structurally reinforce the platform topsides ready for lifting (approximately 1,000Te), and the replacement the 'lost' steel in pile footings decommissioned *in situ* (approx. 2,926Te), will have an indirect energy cost and emissions associated with its manufacture.

The Institute of Petroleum (IoP, now the Energy Institute) Guidelines for calculating estimates of energy use and emissions for decommissioning have been used to inform this assessment [43], and the results are summarised in Table 5.3.1.

SOURCE	DURATION (Days)	RESOURCE (Te)	ENERGY USE (GJ)	% GJ	CO_2 (Te)	% CO_2
DP3 and DP4 Vessel Use		**Fuel Use**				
DSV[1]	56	784	33,790	4.9	2,509	4.4
HLV	84	4,200	181,020	26.5	13,440	23.6
AHT	42	882	38,014	5.6	2,822	5.0
Cargo Barge Tugs	56	1,176	50,686	7.4	3,763	6.6
Fishing Vessel	14	56	2,414	0.4	179	0.3
Supply Vessel	84	840	36,204	5.3	2,688	4.7
Total	**336**	**7,938**	**342,128**	**50.1**	**25,402**	**44.7**
Pipelines Vessel Use						
DSV/CSV	37	518	22,326	3.3	1,658	2.9
Fishing Vessel	22.5	90	3,879	0.6	288	0.5
Total	**59.5**	**608**	**26,205**	**3.8**	**1,946**	**3.4**
TOTAL	**395.5**	**8,546**	**368,333**	**53.9**	**27,347**	**48.1**
DP3 and DP4 Steel Use		Steel				
Recycled[2]	-	20,511	184,596	27.0	19,690	34.6
Manufactured[3]	-	3,010	75,261	11.0	5,687	10.0
Total	**-**	**23,521**	**259,857**	**38.1**	**25,377**	**44.6**
Pipelines Steel Use						
Recycled	-	81	729	0.1	78	0.1
Manufactured	-	2,159	54,704	8.0	4,078	7.2
Total	**-**	**2,239**	**54,638**	**8.1**	**4,152**	**7.3**
TOTAL	**-**	**25,760**	**314,495**	**46.2**	**29,529**	**51.9**
OVERALL			**682,828**		**56,876**	

[1]Includes survey activities
[2]DP3 and DP4 recovered steel inventory, including steel used to reinforce topsides
[3]Includes replacement of DP3 and DP4 steel (i.e. piles) decommissioned in-situ (3,010Te).

Table 5.3.1: Energy use and CO_2 emissions

The impact of NO_x, SO_2 and VOCs in the atmosphere is the formation of photochemical pollution in the presence of sunlight, comprising mainly low-level ozone, but by-products may include nitric acid, sulphuric acid and nitrate-based particulate. The formation of acid and particulates contributes to acid rainfall and the dry deposition of particulates. If such deposition occurs at sea, it is possible that the substances will dissolve in seawater. The ultimate fate of emitted pollutants can often be difficult to predict owing to the dependence on metocean conditions (especially wind), which may be highly variable and lead to wide variations in pollutant fate over short timescales.

TONNES (Te)								
	Total fuel use	CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
Vessels	8,546	27,347	508	2	17	134	2	17

Table 5.3.2: Vessel emissions

Offshore vessel emissions, summarised in Table 5.3.2, will be of localised extent, of relatively short duration, and take place a significant distance (approx. 32km) from the nearest coastline. They are expected to disperse rapidly and dilute to background concentrations, and local air quality impacts would be expected to be minor compared to combustion emissions permitted at the CPC (Permit reference PPC/50). Total direct vessel CO_2 emissions would constitute approximately 0.09% of total UK shipping emissions in 2016 [15]. Vessel fuel consumption will be managed and minimised under the existing marine procedures and the vessels' work programme will be optimised to minimise vessel use.

Power or heat generation for primary or secondary steel smelting, and the associated emissions, are permitted under the Environmental Permitting regime (England) and the Pollution Prevention and Control regime (Scotland). The impact of emissions will have had to have been assessed as 'acceptable' for these permits to have been approved.

The indirect energy required for replacement of 'lost' steel and for recycling of recovered steel has been estimated as approximately 46% of total energy use for the decommissioning activities. This energy use equates to the emission of 29,529Te of CO_2 which is 0.03% of the total CO_2 equivalent (CO_2e) emissions from industry in the UK in 2017 (105MTe CO_2e) [15]. It is not technically feasible to recover the pile footings, and recycling of recovered steel will have a positive impact on resource use.

The significance of the impacts associated with energy use and its atmospheric emissions has been assessed as **low**.

5.3.1 Cumulative and transboundary impacts

Direct emissions from the decommissioning activities represent a very small addition to current levels of shipping (Section 6.4.3). Cumulative impacts associated with atmospheric emissions from CPC combustion activities are possible. However, modelling suggests that CPC emissions disperse and dilute such that concentrations are well within environmental air quality objectives at the nearest onshore location (Blackpool) and the nearest protected areas designated for their ecological importance (HRL, 2012). Project vessels will not all be active in the field at the same time. The HLV, which will be the largest source of project vessel emissions, will temporarily increase emissions of NO_x, CO, and CH_4 from the field by approximately 25%, 40%, and 1.5% respectively compared to background CPC emissions [39]. Due to the distances between field emissions sources and sensitive receptors, no cumulative air quality impact is anticipated.

The impact of carbon emissions on climate change from an individual project is difficult to assess due to the diffuse nature of the inputs and the global impact. However, it is acknowledged that project emissions will make a very small contribution to global concentrations of greenhouse gases in the atmosphere. The increase in emissions will be relatively small and short term, therefore, the significance of the cumulative impact associated with atmospheric emissions has been assessed as **low**.

DP3 and DP4 are located approximately 115km east of UK/Ireland jurisdictional median line and 42km southeast of the territorial waters of IoM. Given these distances, and the anticipated rapid dispersion and dilution of emissions that will occur under prevailing metocean conditions, no significant transboundary impacts associated with atmospheric emissions are anticipated.

5.4 Underwater Sound

Decommissioning activities that are a source of underwater sound include the use of vessels, excavation and cutting tools, lifting and the use of acoustic surveying equipment. Shipping is a key contributor to ambient sound in the marine environment and vessel activities are expected to be the most significant project source.

The primary vessel sound sources are propellers, propulsion and other machinery. The characteristics of the sound produced, in terms of strength or intensity, and range of frequencies, vary with the type of activity and vessel type. Sound levels typically increase with increasing vessel size, with sound pressure levels (SPL) ranging from 160-190dB re 1µPa at 1m [86]. Acoustic energy is strongest in the frequency range 10Hz to 1kHz [103]. Sound levels can be louder when propellers and thrusters are used for dynamic positioning.

By comparison, underwater cutting tools have been reported to produce less acoustic energy than vessels (SPLs of 148-170.5dB re 1µPa) [5]. A recent study of underwater sound from a diamond wire cutting operation found that it was not easily discernible above background noise (which involved the presence of several operational vessels) [78].

Seabed surveys carried out as part of decommissioning will typically employ low energy acoustic surveying equipment such as Side Scan Sonar (SSS) and echo sounders to generate images of the seabed. Neither airguns, or a sub-bottom profiler (SBP), are expected to be used.

Marine mammals and some fish species are potentially sensitive to underwater noise. Sound is important for marine mammals for navigation, communication and prey detection ([92], [86]). Fish species with a swimbladder, which acts as a pressure receiver, have greater hearing sensitivity than fish without a swimbladder ([68], [80]). Section 6.2 describes marine mammal and fish populations in the EIS. The harbour porpoise (*Phocoena phocoena*), white-beaked dolphin (*Lagenorhynchus albirostris*), bottlenose dolphin (*Tursiops truncates*) and grey seal (*Halichoerus grypus*) are the marine mammal species recorded in the EIS, all of which are present at low densities (Section 6.2.4).

Sound levels in the marine environment diminish with distance from the source. The peak sound levels and frequency spectra generated by the project sources of underwater sound are not deemed capable of causing any physical injury to acoustically sensitive species. Shipping density in Blocks 110/3 and 110/8 is high and moderate respectively, in the context of the UKCS (OGA, 2016). There are regular vessel movements in the field due to the continuous presence of the field standby vessel and regular supply vessel visits [4]. Fish and marine mammal behaviour would be expected to be habituated to general vessel sound. Initiation of vessel thrusters is likely to elicit a startle response in fish in the immediate vicinity and may cause marine mammals to move away from the local area during the period of activity. Similarly, more local behavioural responses may be triggered by the use of cutting and excavation tools which generate lower sound levels by comparison. However, the duration of vessel activities, including cutting and excavations, will be minimised, as will vessel size where practicable. Vessel activities will be managed under Spirit Energy's existing marine procedures.

The significance of impacts from underwater sound has been assessed as **low**.

5.4.1 Cumulative and transboundary impacts

Construction of the Walney windfarm extension was completed in 2018, and no other windfarm construction is scheduled in the EIS. Underwater sound generated by decommissioning activities at DP3 and DP4 is, therefore, unlikely to coincide with windfarm construction sound. DP3 and DP4 decommissioning sound sources are expected to be primarily localised, relatively short term increases in vessel noise, in an area of moderate to high shipping activity [72] (Section 6.4.3). The significance of the cumulative impacts associated with underwater sound has therefore been assessed as **low**. Given the distance from the nearest jurisdictional median line, no significant transboundary impacts associated with underwater sound are anticipated.

5.5 Discharges and Releases

Planned decommissioning activities with associated discharges to sea are:

- Pipeline disconnection at the seabed (post-cleaning) discharging any remaining concentrations of chemicals and hydrocarbons; and
- Operational vessel discharges (ballast water, bilge water, general shipboard drainage, treated sewage and grey water from accommodation and amenities).

The pipeline flushing, and cleaning method will be developed during detailed design and agreed with OPRED through the submission of permits, applications, consents and associated consultation. There is also a potential for unplanned (accidental) releases of hydrocarbons or chemicals from vessels or the DP3 and DP4 platform topsides.

Discharges and releases have the potential to impact marine environmental receptors (water quality, plankton, benthos, fish, birds etc.), and cause acute toxic effects where they are concentrated in the immediate vicinity. They may also contribute to more widespread, long term chronic effects if they persist in the environment and bioaccumulate in the food chain.

Offshore chemical use and discharge will be risk assessed and permitted under the Offshore Chemicals Regulations 2002 (OCR) and offshore oil discharges will be risk assessed and permitted under the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended) (OPPC). Any discharge activities will be localised, of short duration or intermittent nature. Although water quality will be reduced at the immediate time and location of discharges, the effects of planned discharges and any small volume unplanned releases will be minimised due to the expected rapid dilution and dispersal of contaminants under ambient metocean conditions.

Vessels used by the project will be managed under Spirit Energy's existing marine procedures and planned operational discharges to sea from them will be subject to on-board control measures designed to secure compliance with the requirements of MARPOL (1973).

Preparatory cleaning of pipelines and the topsides process systems will mean that inventories of chemicals and hydrocarbons will be relatively small. There is a possibility that a small quantity of residual hydrocarbons or chemicals will remain inside of the pipelines, which will corrode and degrade over time potentially leading to a release at some point in the future. Based on available industry degradation studies it is estimated that this would take more than 100 years [88]. Any such release would be very gradual, quantities and concentrations would be low and any impact would be highly localised.

Vessel inventories will also be relatively small, with the exception of diesel fuel tanks. Unplanned releases to sea will be managed under the Morecambe Hub OPEP [40] and project vessel SOPEPs. The risk of a large hydrocarbon release is addressed in Section 7.2.

Onshore, there is potential for discharges and releases associated with materials recovered to shore. These include potential discharges from processing plant, or potential for leachate produced from landfill sites used to disposed of waste materials. They have the potential to contaminate soil, surface water and groundwater. However, all waste management sites and waste carriers used will hold appropriate environmental and other operating licences to control and manage discharges and releases (Section 5.6).

The significance of impacts from discharges and releases has been assessed as **low**.

5.5.1 Cumulative and transboundary impacts

Given the measures described above to minimise discharges of hydrocarbon and chemicals to the marine environment, the relatively small inventories involved, rapid dilution and dispersal, the risk assessments undertaken as part of the OCR and OPPC permitting process, and the absence of other pollution sources in the immediate vicinity, the significance of cumulative impacts associated with marine discharges and releases has therefore been assessed as **low**.

Discharges and releases from the decommissioning of materials onshore will be managed by licenced sites. The significance of cumulative impact associated with onshore discharges and releases has therefore been assessed as **low**. No significant transboundary impacts associated with discharges and releases are anticipated.

5.6 Waste Production

Over 97% of the material recovered from DP3 and DP4 installations decommissioning, by weight, will comprise steel. (Figure 5.6.1). Most of the recovered materials from pipeline decommissioning will comprise concrete, grout and sand (86%), primarily from concrete mattresses and grout bags. For all recovered materials combined, steel will comprise the largest part (93%) followed by concrete, grout and sand (5%). Non-ferrous metals (2%) and plastics and rubber (0.4%) make up the remainder. Estimated inventories are summarised in tonnes in Table 4.6.1.

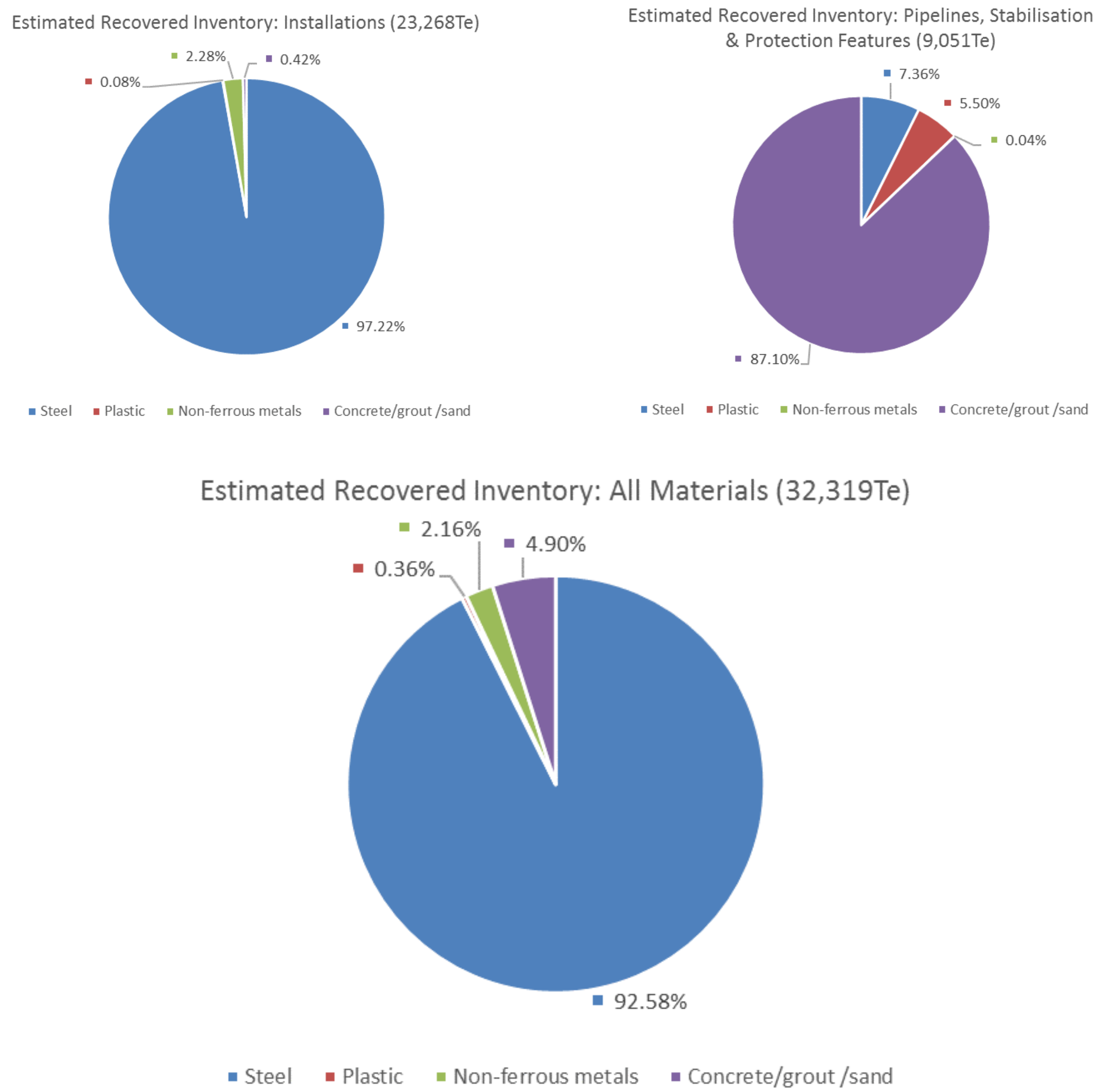

Figure 5.6.1 Estimated inventories of recovered material

Recovered materials will be transported to a shore base for light processing and then transferred to appropriate waste management facilities, according to the principles of the waste hierarchy (see Appendix A: Summary of Waste Legislation). A waste materials inventory will be prepared in advance of the works to inform waste management planning.

Hazardous waste is expected to include materials contaminated with hydrocarbon or chemical residues, radioactive material, and small amounts of asbestos. These will be treated, processed and disposed of as appropriate, in accordance with waste legislation, to optimise their management based on the waste hierarchy.

Recovered materials that have been exposed to production fluids will be tested for Naturally Occurring Radioactive Material (NORM) offshore. Historically, NORM accumulation has not been an issue for the South Morecambe field. However, discharge of NORM to sea is permitted at DP3 and DP4 under the conditions of their Radioactive Substances Act (1993) Certificates of Authorisation, and this may take place during cleaning of the production vessels. If, after cleaning, NORM contaminated items are identified, they will be contained, tagged and shipped to shore for treatment and disposal at a licensed processing facility.

The DP3 and DP4 jackets have radioactive sources (Caesium 137) and sensors on the top of the pile sleeves (12 on DP3 and 8 on DP4) that were used during installation to measure the density of the grout securing the piles to the pile sleeves. These ‘densitometers’ will be recovered as part of the jackets, removed by specialist contractors onshore and returned to their licence holder (original supplier).

DP3 and DP4 have no substantial F-gas inventories. The only F-gas on board is in domestic refrigerators which will be disposed of by licenced waste contractors.

Marine growth will be managed by the selected shore base in line with best industry practice. This normally involves landfilling or composting. The major sources of odour following removal of structures can be associated with degradation of marine growth.

The potential impacts from waste management are principally located onshore and are associated with disposal to landfill. They include use of landfill space and possible nuisance to the local community from odour. Degradation of the water environment associated with discharges from processing plant, or any leachate produced by the landfill site, is discussed in Section 5.5.

The project aspiration is to recycle >95% of recovered materials and it is expected that the final proportion will be greater than this. Energy use and emissions associated with materials processing are considered in Section 5.3. All waste management sites and waste carriers will hold appropriate environmental and other operating licences. Under the Environmental Permitting regime (England and Wales) or the Pollution Prevention and Control regime (Scotland) the impacts to air, land, water and to the local community, will have already been assessed as acceptable prior to the issuing of permits. Compliance with the relevant waste legislation will be closely managed within contractor assurance processes.

The significance of impacts associated with waste production has been assessed as **low**.

5.6.1 Cumulative and transboundary impacts

The UK is a well-developed area of oil and gas infrastructure with many mature assets and as such the cumulative impacts of decommissioning waste should be considered. The timing of DP3 and DP4 decommissioning activities may overlap with the other decommissioning projects in the area, though the exact dates are yet to be defined. Discussions will be held with waste management contractors to ensure that there is capacity and suitable recycling and disposal routes for materials once the precise dates are known. In addition, Spirit Energy is working with other operators in the area to identify opportunities to collaborate where possible. The significance of cumulative impacts associated with waste production has therefore been assessed as **low**.

It is unknown at the time of writing whether the shore base for receiving recovered materials will be in the UK or abroad. Only permitted facilities would be used for recycling or disposal in the UK, or elsewhere. The significance of the transboundary impacts associated with waste production has therefore been assessed as **low**.

6. ENVIRONMENTAL BASELINE

This section describes the main characteristics of the offshore environment near the South Morecambe Field. Attention will be given to receptors that may be sensitive to proposed DP3 and DP4 decommissioning activities. Table 5.6.1 summarises environmental surveys completed near DP3 and DP4 and used to inform the environmental baseline description. The relative locations of these surveys are illustrated in Figure 6.2.1. A pre-decommissioning environmental survey covering the DP3 and DP4 locations will be completed prior to project execution.

SURVEY	YEAR	DISTANCE (km)	LICENSE BLOCK	KEY FINDINGS
DP3 Acoustic Monitoring Survey	2017	0	110/8a	• Clayey sandy silt with megaripples. • No habitats of conservation significance.
DP4 Acoustic Monitoring Survey	2017	0	110/3a	• Generally flat, featureless clayey sandy silt. • No habitats of conservation significance.
South Morecambe Ventnor Location Environmental Baseline Survey	2011	5.2	110/8a	• Homogeneous fine sand. • Total hydrocarbon concentrations (THC) lower than the NOAA ERLs (Effects Range Low) (2008). • No habitats of conservation significance.
Irish Sea Regional Survey (Station 9)	2008	6.5	110/3	• Clayey mud. • Fauna dominated by molluscs and polychaetes, the most abundant species were *Mysella bidentata* (44), *Amphiura filiformis* (48).
Bains to South Morecambe Terminal Environmental Baseline Survey	2009	7	110/3c	• Clayey sandy silt. • Slightly elevated total sediment hydrocarbons (THC) and polycyclic aromatic hydrocarbon (PAH) concentrations. • Polychaetes dominant in the silty sediments at the proposed well. Identified as circalittoral sandy mud (SS.SMu.CSaMu), probably "*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud".
Whitbeck Site Survey	2008	8.8	110/3	• Muddy sand/coarse silt. • Mean total hydrocarbon concentrations (THCs) within background thresholds for the region. • Fauna dominated by molluscs and polychaetes, the most abundant species were *Amphiura filiformis* and *Mysella bidentate.* • No habitats of conservation significance.

Table 5.6.1: Relevant existing survey data

6.1 Physical environment

6.1.1 Meteorology and hydrology

The Irish Sea features a mild maritime climate due to the warming influence of the North Atlantic Current (NAC) with a mean air temperature of 7°C in January and 14°C in July. The annual mean sea temperature in the area is 10°C [87]. The annual mean significant wave height in Blocks 110/3 and 110/8 is approximately 1.16m [1].

Tides in the EIS are semi-diurnal and there is a large tidal range. The modelled Highest Astronomical Tide (HAT) at DP3 and DP4 is 7.9m above LAT and Mean Sea Level (MSL) is 3.85m above LAT [26]. Tidal currents in the South Morecambe Field are aligned approximately to an east-west axis, under the influence of the flow through Lune Deep, the main channel into Morecambe Bay.

The nearest tidal diamond (located NW of DP4 at 54°06.0' N 4°08.6'W) references peak flow on spring flood tides at 1.7 knots (0.87ms^{-1}) at an orientation of 65°, with the returning ebb tide running at 1.4 knots (0.72ms^{-1}) at 236°. Simulated peak annual tidal current speeds at DP3 and DP4 are 1.23ms^{-1} at the surface and 0.49ms^{-1} at the seabed in the easterly flood tide [26]. Metocean models indicate that current speeds reduce with increasing depth. UKSeaMap classes the seabed in the area as moderately disturbed, based on peak kinetic energy from currents and wave action. Moderate tidal currents are in the range 0.5-1.5ms^{-1} [67].

6.1.2 Bathymetry

The DP3 is in a water depth of approximately 22m. Recent survey information shows that the seabed around DP3 increases in depth gradually from 21.3m below LAT to 23.4m below LAT in a north-westerly direction over the 1km^2 survey area centred around the platform. Localised seabed depressions of up to 1m exist around the southeast and southwest platform legs possibly because of scour [27]. Water depth along DP3 pipelines and cables increases steadily to approximately 26m at CPP1 south side.

DP4 is in a water depth of approximately 25m. An equivalent survey around DP4 revealed water depths ranging from 24.1m below LAT to the northeast, increasing to 27.1m below LAT to the west. Seabed depressions up to 1.5m deeper than the surrounding seabed surround all four platform legs, possibly because of scour [28]. Water depth along DP4 pipelines and cables increases steadily to approximately 27m at CPP1 north side, and to approximately 29m at DP8.

Recent bathymetric surveys have indicated slight surficial variations (mobile megaripples) along the length of the pipelines, but overall the seabed level is little changed since 1986.

6.1.3 The seabed

6.1.3.1 Sediment characteristics

The South Morecambe Field is located in an area of seabed characterised by fine sediments consisting mud and sand [21] (Figure 6.1.1). Seabed surveys have interpreted the composition of the seabed within approximately 500m of the DP3 and DP4 platforms as primarily clayey sandy silt with what are believed to be small areas of gravel with sand patches around the bases of the platforms [27], [28]. It is also possible that stiff clay may be encountered 1m below the seabed based on the survey results from the Bains well location [75]. However, no ground truthing data are currently available to confirm this interpretation. This information will be obtained by a pre-decommissioning environmental survey prior to project execution, to support execution phase permit applications.

Sediment samples taken close to the Bains well location, approximately 7km to the east of DP4, identified clayey sandy silt [75]. Surveys of the South Morecambe-Ventnor site, approximately 5.2km south of DP3 also identified homogeneous fine sand, with low proportions of fine sediments

[25]. These survey results are consistent with the muddy sand sediments expected within this part of the Irish Sea which has been described as the Eastern Irish Sea Mudbelt [49].

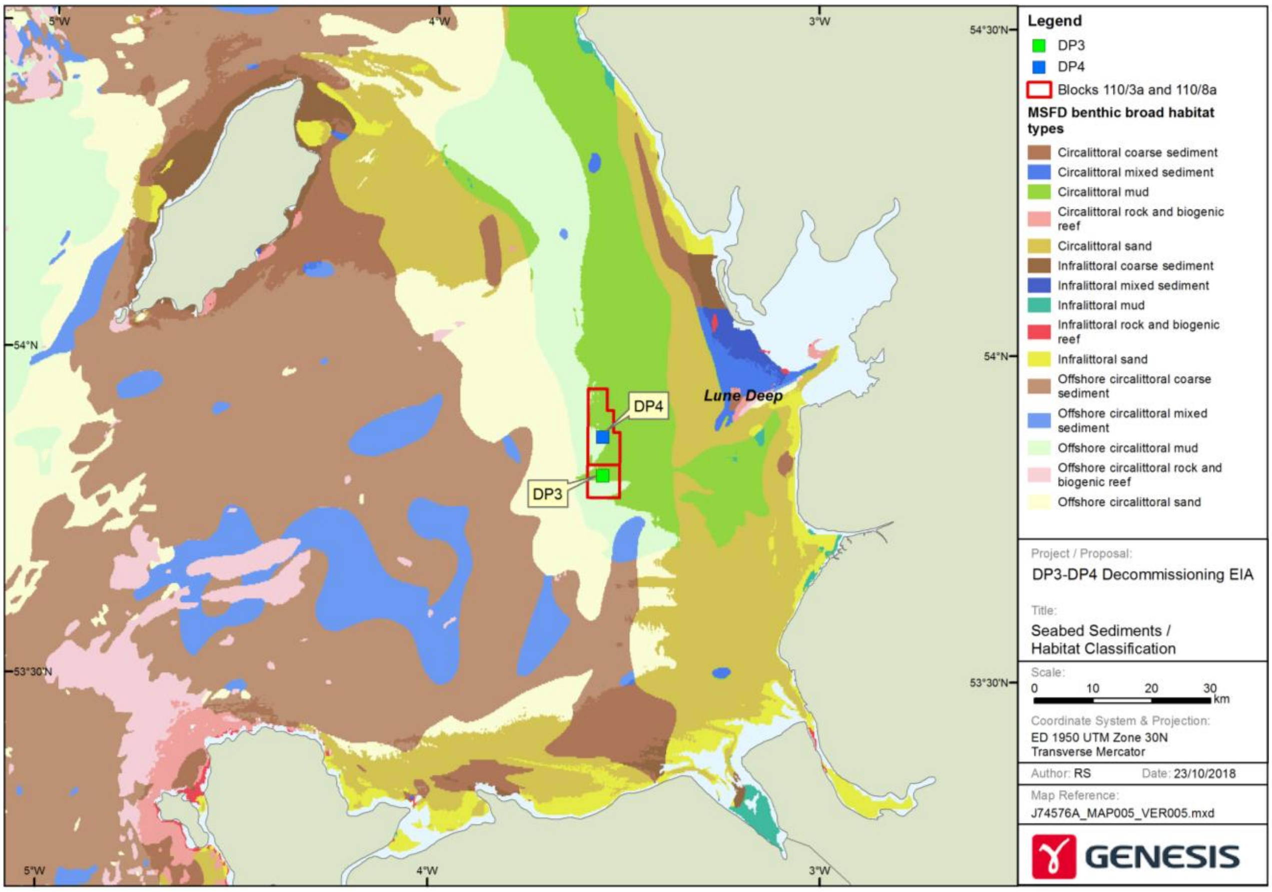

Figure 6.1.1: Seabed sediments and habitats classification within the EIS [94]

6.1.3.2 Sediment chemistry

The pre-decommissioning environmental survey will analyse the chemistry of sediments around DP3 and DP4. The nearest available information is from the Bains well location where the THC of sediments was high (35.5 to 57.8µg^{-1}) compared to areas of the North Sea (mean ca. 8µg.g^{-1}, [99]) but in line with background values for areas of the Irish Sea with fine sediments. This reflects the natural process of hydrocarbon depositions in areas of lower sediment mobility but would suggest a source of hydrocarbons present within the area. Polycyclic aromatic hydrocarbon (PAH), heavy and trace metal concentrations were moderate and within the expected range for the northern Irish Sea. Like THC, concentrations were higher in areas of fine sediment than in coarse, mobile sediments [75]. Similar results might be expected at DP3 and DP4, however the scour near DP3 and DP4 suggests this is a relatively high energy environment where sediment mobility is expected to be high.

6.1.3.3 Seabed habitats

Recent site surveys observed megaripples in clayey sandy silt around DP3 oriented east to west, with wavelengths of up to 10m and heights of up to 0.2m [27]. No megaripple features were observed at DP4 [28]. Geophysical data did not identify any seabed features or hard substrate indicative of habitat of conservation value, including those listed under Annex I of the Habitats Directive (1992), implemented by the Offshore Marine Conservation (Natural Habitats, &c.) Regulations (2007 (as amended)).

6.1.3.4 Cuttings piles

No cuttings piles exist at DP3 or DP4, as confirmed by interrogation of a number of acoustic monitoring surveys examining the seabed near at the platform legs, the most recent of which was in 2017 [27], [28]. Cuttings are widely dispersed and fall below OSPAR Recommendation 2006/5 thresholds.

6.2 Marine flora and fauna

6.2.1 Plankton

The plankton community may be broadly divided into a plant component (phytoplankton) and an animal component (zooplankton). Spring and autumn blooms occur due to increased sunlight, temperature and nutrient availability; these blooms support most of the marine food chains in the area. The phytoplankton community within the Irish Sea is typically dominated by diatom species (e.g. *Chaetoceros* spp., *Thalassiosira* spp., *Leptocylindrus danicus* and *Leptocylindrus minimus*) from December to May and dinoflagellates (e.g. *Ceratium, Gymnodinium and Scripsiella* and *Noctiluca scintillans*) during the summer months [8]. The zooplankton community is dominated by copepods such as *Pseudocalanus elongatus*, *Temora longicornis* and *Acartia clausi* among the most numerous [54].

6.2.2 Benthos

Benthos describes the organisms that live in and on the seabed. Knowledge of the composition of benthos, including the infauna (invertebrates that live within bottom sediments) and epifauna (mobile or sessile species living on the seabed) is important when predicting the potential ways in which the proposed operations might disturb the benthic environment.

Benthic fauna is generally characterised by geographical and sediment features, and therefore benthic communities in the South Morecambe field are expected to be those associated with the fine sediments of the Eastern Irish Sea Mudbelt (Section 6.1.3).

The closest available seabed samples to DP4 are from a Bains well survey in 2009 (Block 110/3c; approximately 7km east of DP4) and the 2008 Irish Sea Regional Survey (Station 9; Block 110/3, approximately 6.5km northeast of DP4) (Figure 6.2.1). Both identified cohesive sandy mud characterised by abundant to superabundant brittlestar *Amphiura filiformis* with the burrowing bivalve mollusc *Mysella bidentata* ([75], [36]). These species are frequently recorded co-occurring in high numbers in the UK as a result of their commensal relationship [84] and have been previously observed elsewhere in Block 110/3 ([29], [30]). Other than *M. bidentata*, infauna was dominated by polychaete worms. Brittlestars were the most conspicuous surface fauna, with the brittlestars *Ophiura ophiura* and *Ophiura affinis* also present [75].

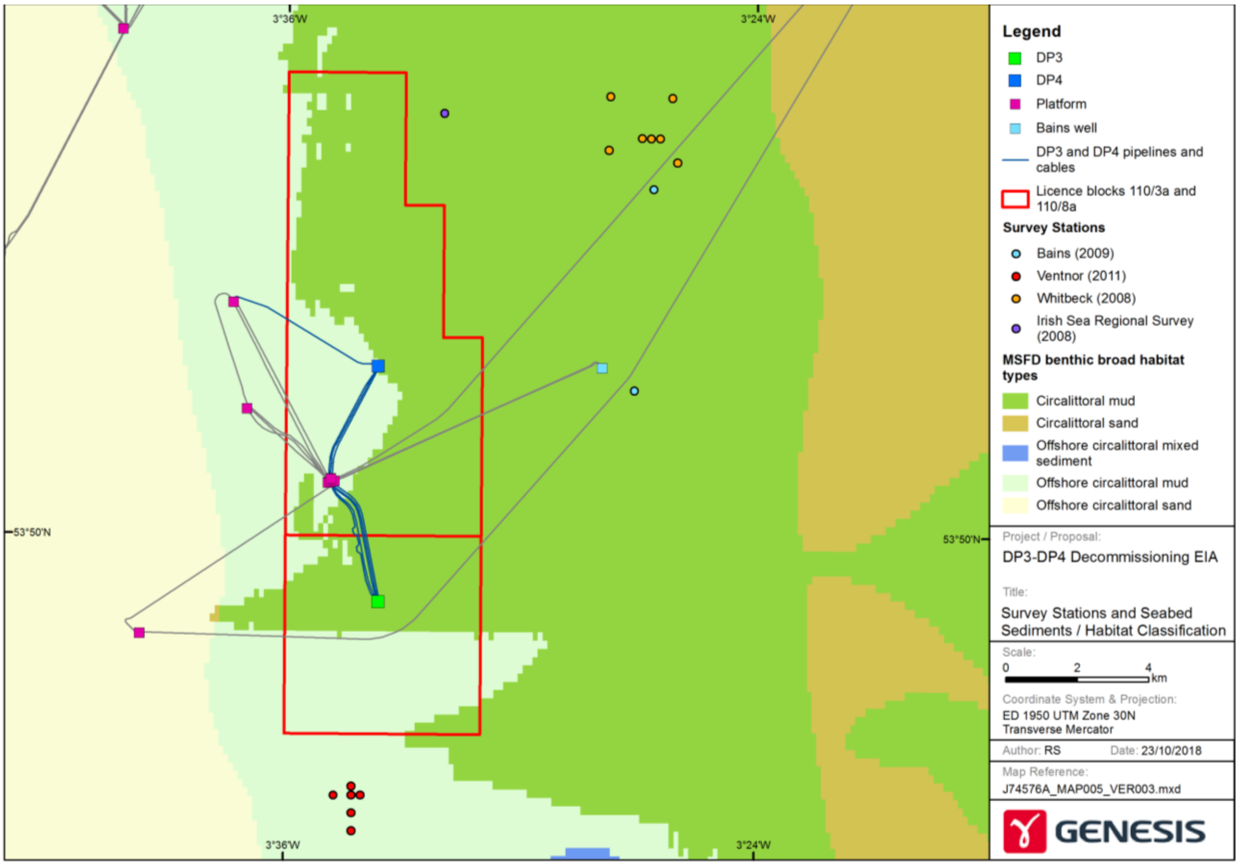

Figure 6.2.1: Survey sample stations and seabed habitats in the area

The closest available seabed samples to DP3 are from the South Morecambe-Ventnor survey, approximately 5.2km south of DP3, identified the circalittoral muddy sand biotope complex dominated by annelid worms [25]. The closest Ventnor survey sample locations were also characterised by the presence of *M. bidentata* and brittlestars.

This community occurs in muddy sands in moderately deep water and is identified as circalittoral sandy mud (SS.SMu.CSaMu), probably '*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud' (SS.SMu.CSaMu.AfilMysAnit) [75] under the Marine Habitat Classification for Britain & Ireland (Figure 6.2.2). This is equivalent to the European Nature Information System (EUNIS) biotope 'circalittoral sandy mud' (A5.35). As described, the three survey locations closest to DP3 and DP4 all describe similar benthic communities that fit this classification. The benthic communities at DP3 and DP4 will be confirmed by the pre-decommissioning environmental survey.

Sediment	Mean %	Station 9
Cobbles (>64mm)	0	
Pebbles (>16mm)	0	
Gravel (>4mm)	0	
Sand (<2mm)	100	
Mud/silt	Present	
Low energy clayey sandy silts, with no coarse sediment admixtures.		
Cohesive sandy mud characterised by abundant to super-abundant *Amphiura filiformis* with *Mysella bidentata*. This community occurs in muddy sands in moderately deep water. Conspicuous surface fauna were predominantly Ophiuroids *Ophiura ophiura and O.affinis.*		
Biotope: SS.SSa.CSaMu probably SS.SMu.CSaMu.AfilMysAnit		

Figure 6.2.2: Seabed near the Bains well location (Station 9) [75]

6.2.3 Fish and shellfish

At present, more than 330 fish species are thought to inhabit the shelf seas of the UKCS [8]. Many of these species are widespread, having large extended spawning and nursery grounds. The most vulnerable stages of the fish lifecycle to general disturbances (sediment disruption, chemical/hydrocarbon discharges) are the egg and larval stages, hence recognition of spawning and nursery grounds within the area of proposed decommissioning activities is important. Table 6.2.1 and Figure 6.2.3 detail the distribution and timing of fish spawning, and the location of fish nursery grounds, as described by Coull *et al.* [17] and Ellis *et al*. [20].

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	NURSERY
Cod[1,2]	Spawning	Peak Spawning	Peak Spawning	Spawning									
Whiting[1]		Spawning	Spawning	Spawning	Spawning	Spawning							Nursery ground
Plaice[1]	Peak Spawning	Peak Spawning	Spawning									Spawning	Nursery ground
Sprat[1]					Peak Spawning	Peak Spawning	Spawning	Spawning					Nursery ground
Lemon sole[1]				Spawning	Spawning	Spawning	Spawning	Spawning	Spawning				Nursery ground
Sole[1]			Spawning	Peak Spawning	Spawning								Nursery ground
Herring[1,2]													Nursery ground
Nephrops[1,2]	Spawning	Spawning	Spawning	Peak Spawning	Peak Spawning	Peak Spawning	Spawning	Spawning	Spawning	Spawning	Spawning	Spawning	Nursery ground
Ling[2]		Spawning	Spawning	Spawning	Spawning								
Anglerfish[2]	Spawning	Spawning	Spawning	Spawning	Spawning	Spawning							
Spurdog[2]													Nursery ground
Sandeel[2]	Spawning	Spawning									Spawning	Spawning	Nursery ground
Mackerel[2]			Spawning	Spawning	Peak Spawning	Peak Spawning	Spawning						Nursery ground
Tope shark[2]													Nursery ground
Thornback ray[2]													Nursery ground
Spotted ray[2]													Nursery ground
KEY:	Spawning					Peak Spawning					Nursery ground		

Table 6.2.1: Fish spawning & nursery timings near Blocks 110/3a and 110/8a [17][1] , [20][2])

It should be noted that spawning and nursery areas tend to be transient, indicative of seasonal and annual temporal change, and therefore cannot be defined with absolute accuracy. Species thought to spawn in the area include *Nephrops* or Norway Lobster (*Nephrops norvegicus*), a small lobster found in areas of fine cohesive mud which is stable enough to support their unlined burrows, including parts of the EIS. This species is less transient, having specific seabed habitat preferences described as circalittoral fine mud (SS.SMu.CFiMu) [52]. Nearby habitat surveys suggest that the seabed around the South Morecambe Field is characterised by circalittoral sandy mud and did not record the presence of *Nephrops* (Section 6.2.2).

Similarly, DP3 and DP4 are located within a recognised sandeel (*Ammodytes marinus*) spawning area (Figure 6.2.3). Sandeels have specific habitat preferences and are found in coarse and medium sand seabed areas in to which they burrow [37]. Sandeels also deposit their eggs on the seabed. The larvae hatch after several weeks, usually in February-March, and drift in the currents for one to three months, after which they settle on sandy seabed areas [64]. However, the sandy mud seabed observed around DP3 and DP4 is not a preferred sandeel habitat [37].

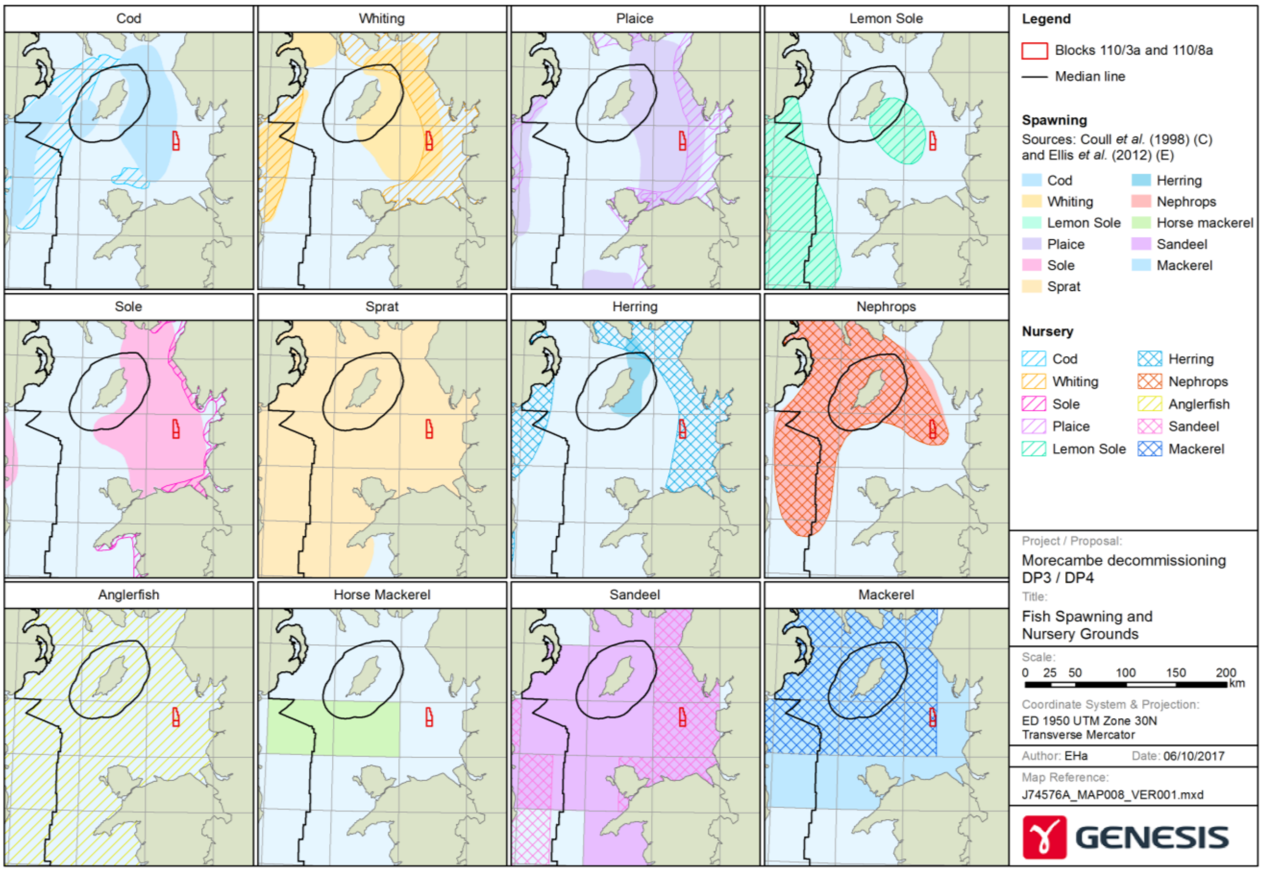

Figure 6.2.3: Fish species spawning and nursery in the EIS [17], [20]

6.2.4 Marine mammals

The distribution of cetacean species in UK waters has been compiled in the Atlas of Cetacean Distribution in North-West European Waters [85]. The data suggest that harbour porpoise (*Phocoena phocoena*), bottlenose dolphin (*Tursiops truncatus*), and white beaked dolphin (*Lagenorhynchus albirostris*) occur in the EIS at relatively low densities (Figure 6.2.4), with harbour porpoise being the most common species.

A series of Small Cetacean Abundance in the North Sea (SCANS) surveys have been conducted to obtain an estimate of cetacean abundance in North Sea and adjacent waters, the most recent of which is SCANS-III. Aerial and shipboard surveys were carried out during the summer of 2016 [34]. DP3 and DP4 are located within SCANS-III Survey Block F. The Joint Nature Conservation Committee (JNCC) have published the 'regional' population estimates for the most common species of cetacean occurring in UK waters [42]. Divided into local management units (MUs), these provide an indication of the spatial scale and the relevant populations at which potential impacts should be assessed. The results of the SCANS-III survey indicated that approximately 2.5% of the Irish Sea MU population of harbour porpoise are within Block F at a density of 0.086 animals per km^2 (Table 6.2.2).

All cetacean species in UK waters are classified as European Protected Species (EPS). As such it is an offence to deliberately kill, capture, or disturb a EPS, or to damage or destroy the breeding site or resting place of such an animal.

SPECIES	SCANS-III SURVEY BLOCK F **ABUNDANCE**	SCANS -III SURVEY BLOCK F **DENSITY (animals/km²)**	**MANAGEMENT UNIT POPULATION**	**% OF RELEVANT MANAGEMENT UNIT (Irish Sea)**	**Irish Sea MU SCALED ABUNDANCE**
Harbour porpoise	1,056	0.086	104,695	2.5	2,617

Table 6.2.2: Harbour porpoise density [34], MU population [42] and scaled abundance [79]

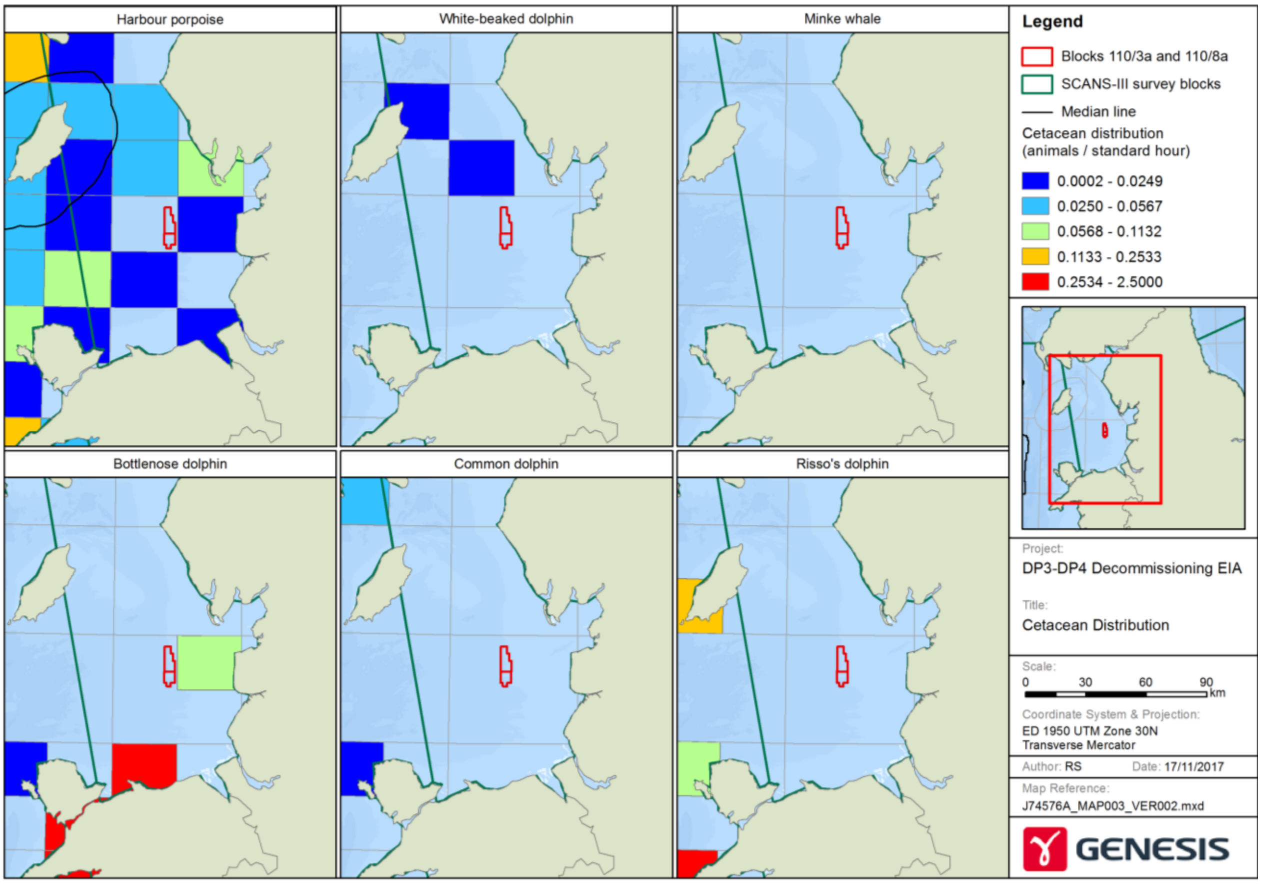

Figure 6.2.4: Annual distribution of cetaceans in the EIS [85]

Two species of pinnipeds are found within UK waters, the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Although both species are Annex II species, they are not listed on Annex IV of the Habitats Directive, and as such are not classified as European Protected Species (EPS). Seals are protected in the UK under the Conservation of Seals Act 1970 and in Scotland under the Marine (Scotland) Act 2010.

Distribution maps based on telemetry data (1991 - 2016) and count data (scaled to the estimated population size in 2015) indicate that harbour seals are unlikely to occur in the area. Grey seals may be present at low densities ranging between 5 and 10 individuals per 25 km [90] (Figure 6.2.5).

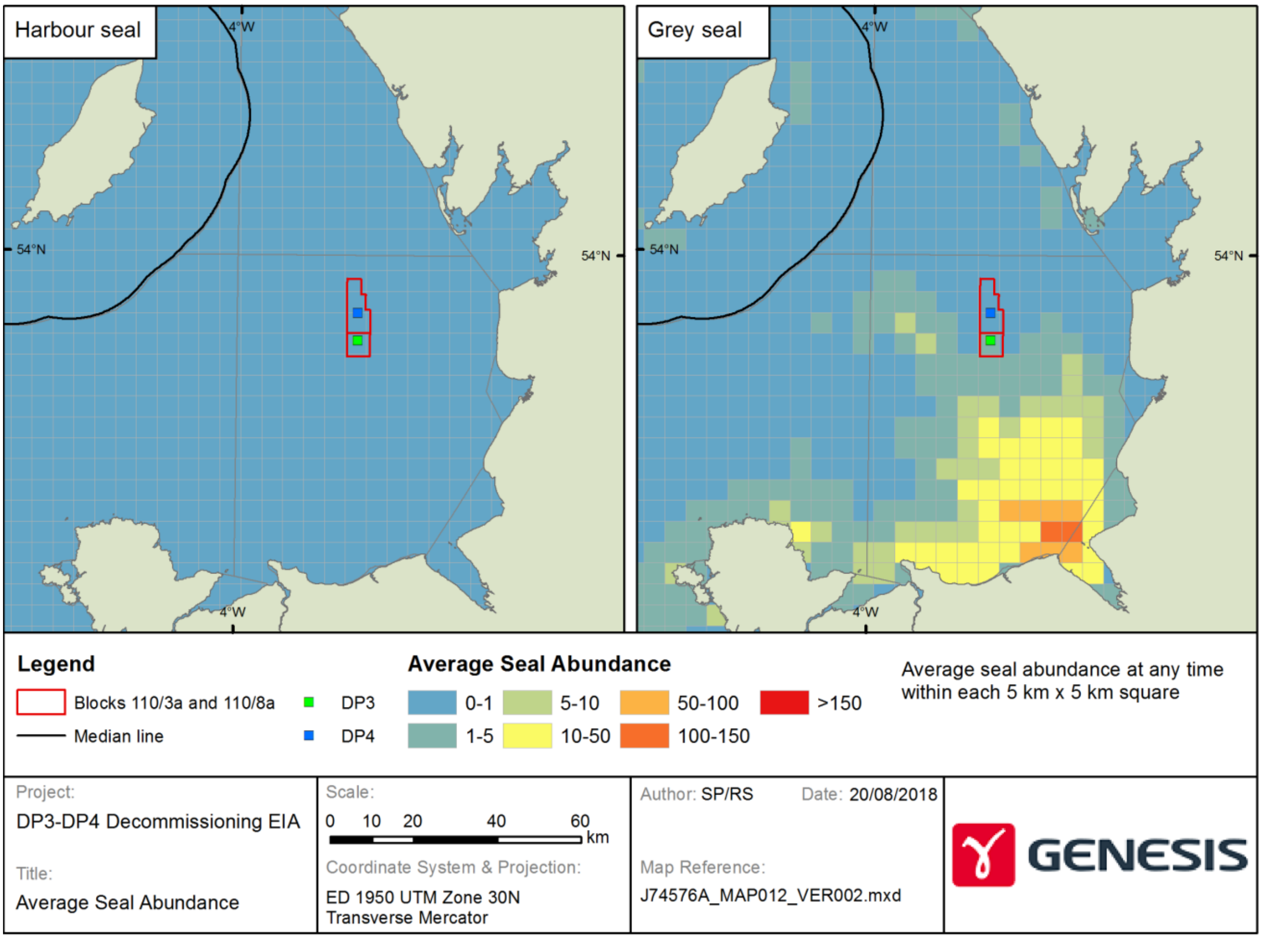

Figure 6.2.5: Average seal abundance in the EIS [90]

6.2.5 Seabirds

The Irish Sea and bordering coastlines is known to be nationally and internationally important for a variety of breeding and wintering seabirds, as well as for migrant and wintering wildfowl and wading birds associated with estuaries and other coastal habitats. Numerous areas around the Irish Sea basin are designated as protected areas for their ornithological interest. These are described in Section 6.3.1.

However, evidence suggests that seabirds do not use the area around DP3 and DP4 in high numbers.

Table 6.2.3 shows the predicted maximum abundance of seabirds in the area based on an analysis of European Seabirds at Sea (ESAS) data collected over 30 years [55]. For all species combined, a maximum of 9 seabirds are predicted to occur per square kilometre during the breeding season (March to September), whilst during the winter months (November to March) a maximum of 4 seabirds are predicted to occur per square kilometre. Slightly increased densities of common guillemot may be present in the vicinity in July and August when chicks are fledging and they leave the colonies and move offshore accompanied by the male parent [55].

SPECIES	SEASON	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Black-headed gull	Breeding				<1								
	Winter									<1			
Black legged kittiwake	Breeding					1.5							
	Winter										1.7		
Common Guillemot	Breeding					3.7							
	Winter										2.5		
	Other								10.7				
Common gull	Breeding					<1							
	Winter									1.1			
Common tern	Breeding					1.4							
Cormorant	Winter									<1			
Gannet	Breeding					2.9							
	Winter										<1		
Great black-backed gull	Breeding				<1								
	Winter									<1			
Great skua	Breeding					<1							
	Winter									<1			
Herring gull	Breeding				1.1								
	Winter									3.3			
Lesser black-backed gull	Breeding					4							
	Winter									1.1			
Little gull	Winter												<1
	Other								<1				
Manx shearwater	Breeding					3.7							
Northern fulmar	Breeding			4									
	Winter								2				
Razorbill	Breeding					<1							
	Winter										<1		
	Other								1.1				
Sandwich tern	Breeding					<1							
Sooty shearwater	Summer							<1					
All species combined	Breeding			9									
	Summer							17					
	Winter											4	

Key	0	>0 - 10	>10-20	>20 - 50	>50 - 100	>100

Table 6.2.3: Predicted seabird surface density in DP3, DP4 area (max. no. of individuals/km^2) [13], [55]

Seabirds are generally not at risk from routine offshore operations. However, they may be vulnerable to pollution from accidental events, for example from accidental hydrocarbon releases.

The Seabird Oil Sensitivity Index (SOSI) is a tool which aids planning and emergency decision making with regards to oil pollution. It identifies areas at sea where seabirds are likely to be most sensitive to oil pollution. It is based on seabird survey data collected from 1995 to 2015, from a wide survey area extending beyond the UK Continental Shelf using boat-based, visual aerial, and digital video aerial survey techniques [50].

This seabird data was combined with individual seabird species sensitivity index values [104]. Sensitivity index values are based on several factors which are considered to contribute towards the sensitivity of seabirds to oil pollution, including:

- Habitat flexibility (a species ability to locate to alternative feeding sites);
- Adult survival rate;
- Potential annual productivity; and,
- The proportion of the biogeographical population in the UK.

The combined seabird data and species sensitivity index values are subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution. This is presented as a series of fine scale density maps for each month that show the median, minimum and maximum seabird sensitivity to oil pollution, and an indication of data confidence. The index is independent of where oil pollution is most likely to occur; rather, it indicates where the highest seabird sensitivities might lie if there were to be a pollution incident.

The median sensitivity SOSI data for the area surrounding DP3 and DP4 is shown in Figure 6.2.6. Median sensitivity is extremely high around DP3 in January, and very high around both DP3 and DP4 from October to March. Sensitivity reduces through the spring as seabirds migrate to coastal breeding areas, and is lowest between June and October when sensitivity is considered medium to low, except in August when sensitivity is considered to be high around DP4.

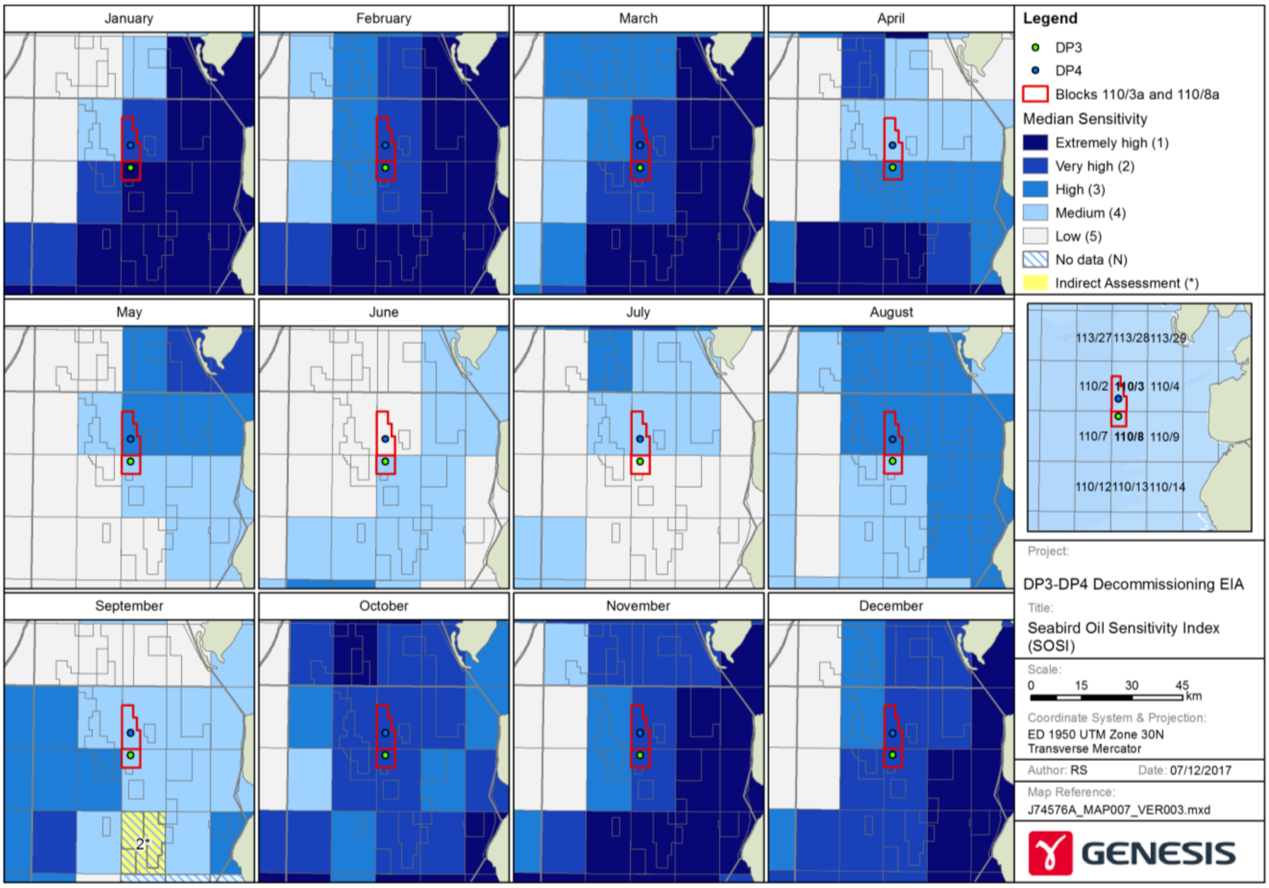

Figure 6.2.6: SOSI and indirect assessment of seabird sensitivity [50]

Large areas of the coastline EIS coastline are designated as protected areas (Section 6.3.1.1).

The Liverpool Bay/Bae Lerpwl Special Protection Area (SPA) encompasses DP4 and is 1.4km to the north of DP3 at its the nearest point (Section 6.3.1.1) following an extension of the site boundary to incorporate important areas for non-breeding little gull (*Hydrocoloeus minutus*) over the winter period (October to March), illustrated in Figure 6.2.7.

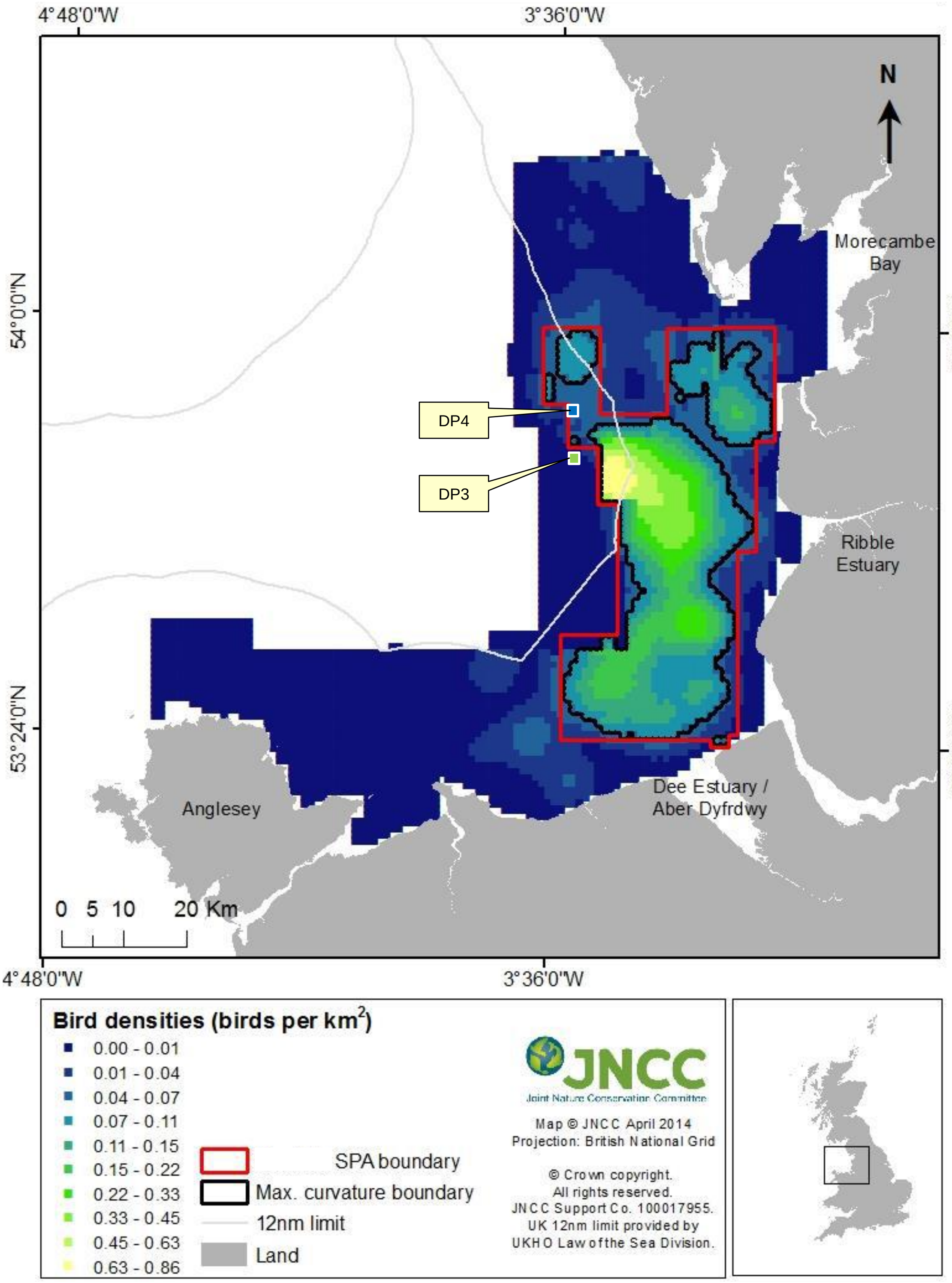

Figure 6.2.7: Important areas for non-breeding little gulls in Liverpool Bay [58]

6.3 Habitats and species of conservation concern

Several areas designated for the protection of coastal and marine habitats and species are present in the region. Coastal protected areas fringe the EIS and marine protected areas have been designated to protect offshore habitats. This section describes protected areas within 40km of DP3 and DP4. The locations of protected areas are shown in Figure 6.3.1.

6.3.1 Protected areas

6.3.1.1 Natura 2000 protected areas

The EU Habitats Directive (92/43/EEC) and the EU Birds Directive (2009/147/EC), enacted by UK legislation, are the main driving forces for safeguarding biodiversity in Europe. Through the establishment of a network of protected sites, these directives provide for the protection of animal and plant species of European importance and the habitats that support them. Together, these protected sites form the 'Natura 2000' network in the European Union.

Special Areas of Conservation (SACs)

The Habitats Directive identifies habitats and species (listed under Annexes I and II respectively) whose conservation requires the designation of a series of protected sites known as Special Areas of Conservation (SACs). Sites qualify for selection as SACs if they contain important representative examples of Annex I habitats and important populations of Annex II species.

Of the Annex I habitat types listed as requiring protection in the Habitats Directive, three potentially occur in the UK offshore waters:

- Sandbanks which are always slightly covered by seawater;
- Reefs; and,
- Submarine structures made by leaking gases.

Four of the species listed in Annex II of the Habitats Directive occur in relatively large numbers in UK offshore waters:

- Grey seal;
- Common seal;
- Bottlenose dolphin; and,
- Harbour porpoise.

The nearest SAC to DP3 and DP4 is the Shell Flat and Lune Deep SAC.

Special Protection Areas (SPAs)

The Birds Directive requires member states to identify and nominate sites that support rare and vulnerable birds (as listed on Annex I of the Directive), and regularly occurring migratory species, as Special Protection Areas (SPAs). The Birds Directive provides no formal criteria for selecting SPAs, so the UK developed selection guidelines based on the proportion of species population supported by a site in any season, or whether over 20,000 waterfowl or seabirds regularly use a site [50].

DP4 is located within the Liverpool Bay/Bae Lerpwl SPA and DP3 is located 1.4km to the south of its boundary at the nearest point. The site occupies an area of 2,528km^2 [58] and it is designated to protect a number of bird species, as summarised in Table 6.3.1.

6.3.1.2 Ramsar sites

Ramsar sites are wetlands of international importance designated under the Ramsar Convention.

The first Ramsar sites were designated in the UK in 1976, with the initial emphasis on selecting sites of importance to waterbirds. Consequently, many Ramsar sites are also Special Protection Areas (SPAs). Ramsar sites around the EIS coastline include the Duddon Estuary, Morecambe Bay, and Ribble and Alt Estuaries Ramsar sites, all of which are also SPAs. The Ramsar sites generally extend over the intertidal part of the equivalent SPA designation above the Mean Low Water mark.

6.3.1.3 Marine Conservation Zones

Marine Conservation Zones (MCZs) can be established to protect nationally important marine wildlife, habitats, geology and geomorphology and designated anywhere in English and Welsh inshore and UK offshore waters. They are established under the Marine and Coastal Access Act (2009). The West of Walney MCZ is the nearest designated protected area to DP4. The nearest proposed MCZ (pMCZ) is West of Copeland.

6.3.1.4 Marine Protected Areas in the Isle of Man

The IoM has ten Marine Protected Areas (MPAs), five of which restrict fishing activity. The remainder make up zones of the Ramsay Marine Nature Reserve, protected under IoM legislation through Section 32 of the Wildlife Act 1990 (Manx Wildlife Trust, 2017). These are all located more than 40km from DP3 and DP4, in IoM territorial waters.

6.3.1.5 East Irish Sea protected areas

The locations of protected areas in the EIS, relative to DP3 and DP4, are illustrated in Figure 6.3.1. Those areas within a 40km radius of DP3 and DP4 are summarised in Table 6.3.1 below.

OFFSHORE PROTECTED AREA	CLOSEST TO (DP3/DP4)	APPROXIMATE DISTANCE (KM)	FEATURES OF CONCERN
Liverpool Bay/Bae Lerpwl (SPA)	DP4	0.0	Supports an internationally important waterbird assemblage including important breeding populations of little tern (*Sternula albifrons*) and common tern (*Sterna hirundo*). Also, important non-breeding populations of red-throat diver (*Gavia stellata*), little gull (*Hydrocoloeus minutus*) and common scoter (*Melanittia nigra*) in coastal waters. A recent expansion to the SPA, to incorporate important areas for little gull (*Hydrocoloeus minutus*) outside of the breeding season, now includes the DP4 platform. The boundary is approximately 1.4km north of DP3.
West of Walney (MCZ)	DP4	9.3	Part of the eastern Irish Sea mud belt, the site includes Sea-pen and burrowing megafauna communities, characterised by the presence of sea-pens (feather-like soft corals) and burrowing animals such as mud shrimp and the Norway lobster (*Nephrops norvegicus*). This habitat is a Feature of Conservation Importance (FOCI) and an OSPAR Threatened and/or Declining habitat.
Fylde (MCZ)	DP3	12.5	Broad-scale marine habitat of subtidal sand and mud. Supports rich bivalve mollusc populations and includes important nursery and spawning grounds for several commercially important fish species.

OFFSHORE PROTECTED AREA	CLOSEST TO (DP3/DP4)	APPROXIMATE DISTANCE (KM)	FEATURES OF CONCERN
Shell Flat and Lune Deep (SAC)	DP4	13.6	Qualifies as an excellent example of 'sandbanks which are slightly covered by seawater all the time'. It is characterised by low biodiversity and high biomass and is an important foraging ground for many over wintering bird species. The area includes qualifying reef habitats, particularly in the Lune Deep area, which contains a good example of boulder and bedrock reef, subject to strong tidal currents with a dense hydroid and bryozoan turf. This is a contrasting habitat to the surrounding muddy communities of the eastern Irish Sea Mudbelt.
Ribble and Alt Estuary (SPA and Ramsar)	DP3	24.7	A wintering waterbird assemblage of international importance regularly supporting up to 301,449 individual waterfowl, including bar-tailed godwit (*Limosa lapponica*), Bewick's and Whooper swan, and Golden Plover (*Pluvialis apricaria*). A seabird breeding assemblage of international importance with important populations of common tern (*Sterna hirundo*) and ruff (*Philomachus pugnax*). Additionally, of major importance for birds as a stop off during the spring and autumn migration periods.
Morecambe Bay and Duddon Estuary (SPA)	DP4	24.8	A site of European importance throughout the year for a wide range of bird species. In summer, areas of shingle and sand hold breeding populations of terns, whilst very large numbers of geese, ducks and waders not only overwinter, but (especially for waders) also use the site in spring and autumn migration periods. The bay is of particular importance during migration periods for waders moving up the west coast of Britain.
Morecambe Bay (SAC)	DP4	28.7	Confluence of estuaries forming the largest area of continuous intertidal mudflats and sandflats in the UK, supporting a rich and diverse infauna. Large mussel beds on exposed 'scars' of boulder and cobble, and small areas of reef habitat with seaweed communities. Important saltmarsh areas, coastal dune systems, coastal lagoons and sandbanks which are slightly covered by water at all times.
West of Copeland (pMCZ)	DP4	29.3	An area of mixed subtidal sand, coarse sediment and mixed sediments supporting a variety of species including bivalves, sea urchins, anemones, starfish and sea mats. The site is particularly important to protect coarse sediment seabed habitats in deeper water.
Wyre-Lune (pMCZ)	DP4	33.3	Two estuaries containing important saltmarsh areas and fish nursery areas. This site is being recommended for the protection of smelt (*Osmerus eperlanus*), a species of conservation importance.
Sefton Coast (pMCZ)	DP3	39.8	Rare intertidal peat and clay beds supporting communities of burrowing clams and other invertebrates. These are also an important food source for other species. The beds are also of archaeological interest, preserving evidence of stone age activity in the area.

Table 6.3.1: EIS protected areas

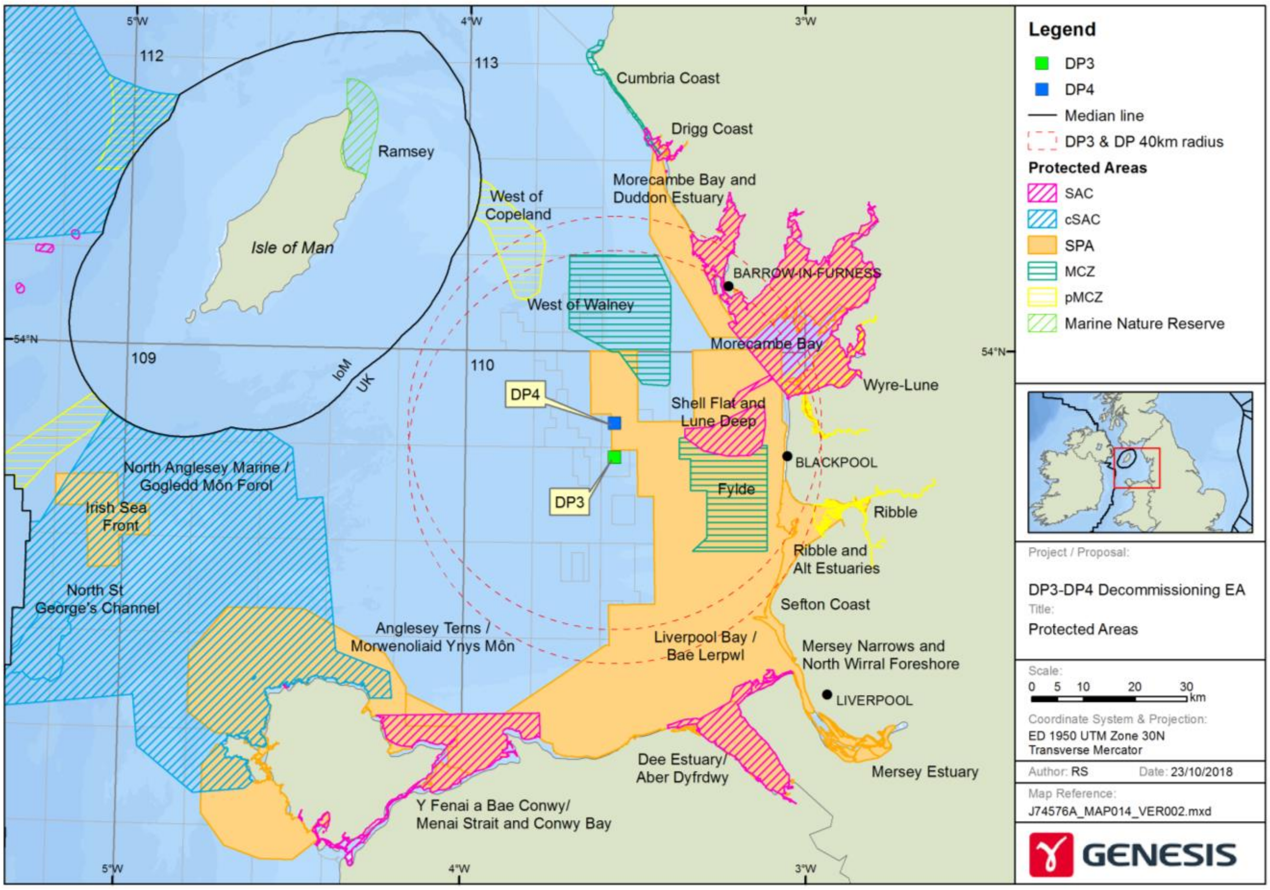

Figure 6.3.1: Protected areas in the region

6.3.2 Habitats of conservation concern

The EIS contains several areas of sandbank features which conform to the Annex I habitat 'sandbanks which are slightly covered by seawater at all times'. The nearest, the Shell Flat feature, is a crescent shaped sandbank comprising a range of mud and sand sediments and associated biological communities. It is located approximately 11.3km east of DP4 and supports commercial fish species and bird populations. Much of this sandbank feature is located within the Shell Flat and Lune Deep SAC, which also contains areas of Annex I reef habitat, particularly in the Lune Deep area in the approaches to Morecambe Bay (Figure 6.3.1 and Table 6.3.1).

6.3.3 Species of conservation concern

Species listed under Annex II of the Habitats Directive and likely to occur in the area include the harbour porpoise, bottlenose dolphin and grey seal. The North Anglesey Marine (Gogledd Môn Forol) candidate SAC (cSAC) for the conservation of harbour porpoise is located approximately 57km from the platforms.

The bottlenose dolphin and harbour porpoise, like all the cetacean species found in UK waters, also have EPS status under Annex IV of the Habitats Directive. Developers must therefore consider the requirement to apply for the necessary licences if there is a risk of causing disturbance or injury to EPS.

Non-commercially important fish species of conservation value that are found in EIS waters include the European sturgeon (*Acipenser sturio*), which is rare, and the common whitefish (*Coregonus lavaretus*), found in estuaries and rivers off the EIS. Both qualify for protection under the Annex II of the Habitats Directive. Other species of conservation value include the basking shark (*Cetorhinus maximus*), tope (*Galeorhinus galeus*) and porbeagle shark (*Lamna nasus*). Of these the basking shark is the most likely to be present in the vicinity of the South Morecambe field in any numbers. The IoM is a hotspot for the species, although sightings are most frequently to the west and southwest of the island [11] during the summer months.

6.4 Socio-economic baseline

6.4.1 Commercial fishing

Fisheries statistics are assigned to statistical areas called ICES (International Council for the Exploration of the Sea) rectangles, each measuring 30nm by 30nm. DP3 and DP4 are in ICES rectangle 36E6 (Figure 6.4.1). Fishing effort (from UK fishing vessels over 10m) within 36E6 varies throughout the year, with an average annual fishing effort of 1,007 days between 2015 and 2017 [87]. Over this period, dredging was the most common fishing method (68%), followed by traps (28%), and finally trawling (3%).

Landings from 36E6 are dominated by shellfish, comprising 97% of landings by weight and 96% by value between 2015 and 2017. In 2017, the most important species (by weight) were queen scallop (43%), scallops (24%) and whelks (19%). However, the contribution of 36E6 to total UK landings is relatively low, averaging 0.4% of the total UK value and 0.6% of the total weight between 2015 and 2017 [87].

SPECIES TYPE	2015		2016		2017	
	VALUE (£)	QUANTITY (te)	VALUE (£)	QUANTITY (te)	VALUE (£)	QUANTITY (te)
Demersal	192,530	153	82,023	72	59,635	40
Pelagic	13	0.008	35	0.018	40	0.013
Shellfish	2,791,318	4,262	3,284,711	4,034	1,874,443	1,589
TOTAL	2,983,862	4,415	3,366,769	4,106	1,934,122	1,628
Effort Total (days)	1,172		1,186		694	

Table 6.4.1: Live weight and value of fish and shellfish in 36E6 during 2015 and 2016 [87]

ICES rectangle 36E6 covers a large area including coastal waters and therefore summary statistics for the rectangle may not may not accurately represent fishing activity around DP3 and DP4. The distribution of fishing effort within ICES rectangle 36E6 is illustrated in Figure 6.4.1 and Figure 6.4.2. The maps show fishing vessels of 15m or more in length, which must carry an Automatic Identification System (AIS) that enables vessel monitoring by satellite. The lack of comprehensive data on fishing vessels below 15m in length is not considered to be significant because these vessels tend to fish inshore waters [4].

Fishing activity is concentrated to the south and west of the platforms and is low in their immediate vicinity (Figure 6.4.1). This is supported by the Morecambe Field vessel collision risk assessment, which shows little or no fishing vessel activity around DP3 and DP4 (October 2014 to September 2015). The nearest fishing vessels recorded were travelling more than 5 knots and were therefore probably in transit. Concentrations of vessel activity <5 knots, and therefore likely to be fishing, were to the south and west. Most of fishing vessels in the area were potters (43%) or dredgers (39%) (Figure 6.4.2).

In coastal areas such as Morecambe Bay, benthos including cockles are harvested from intertidal mud and sandflats. Mussels are also cultivated in Morecambe Bay and along the North Wales coast [8], and designated shellfish waters are in place in key areas to manage water quality (Figure 6.4.1).

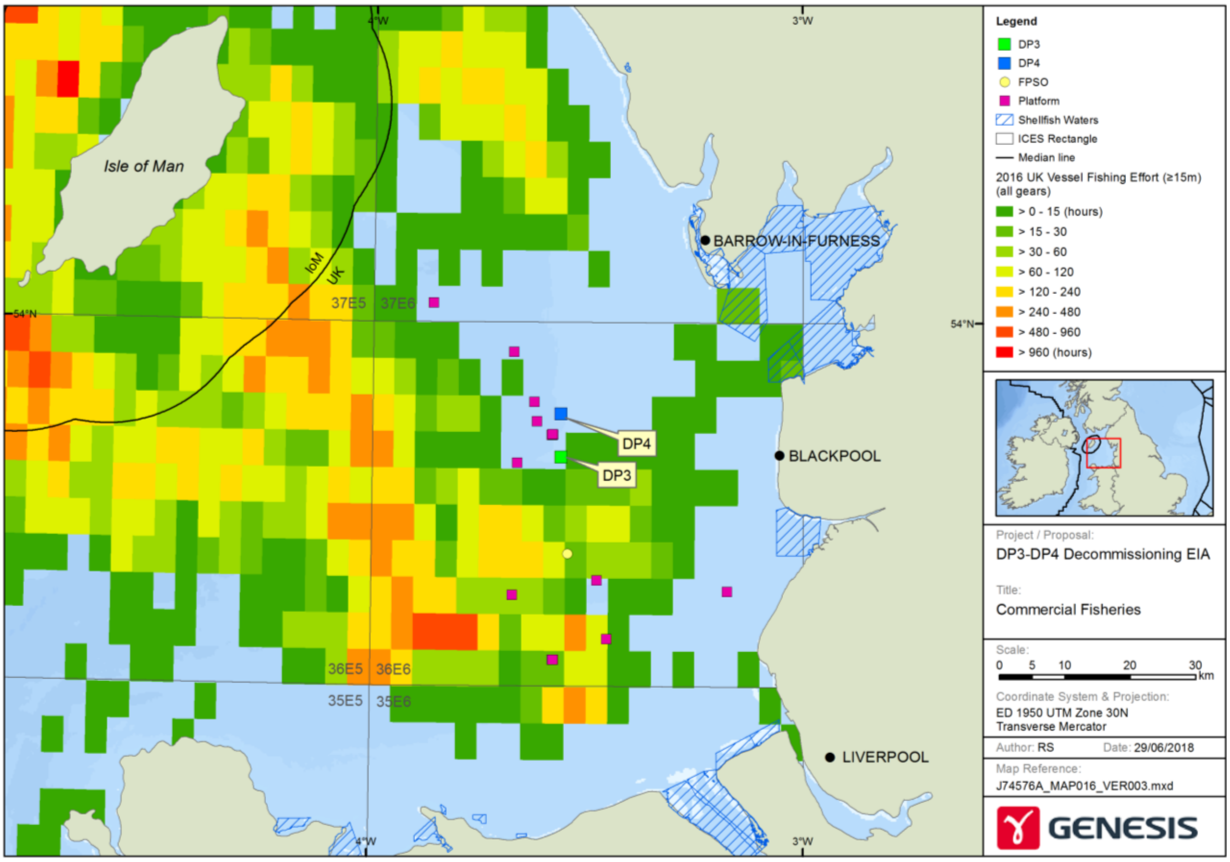

Figure 6.4.1: Offshore fishing effort (2016) and designated shellfish waters in the EIS [62]

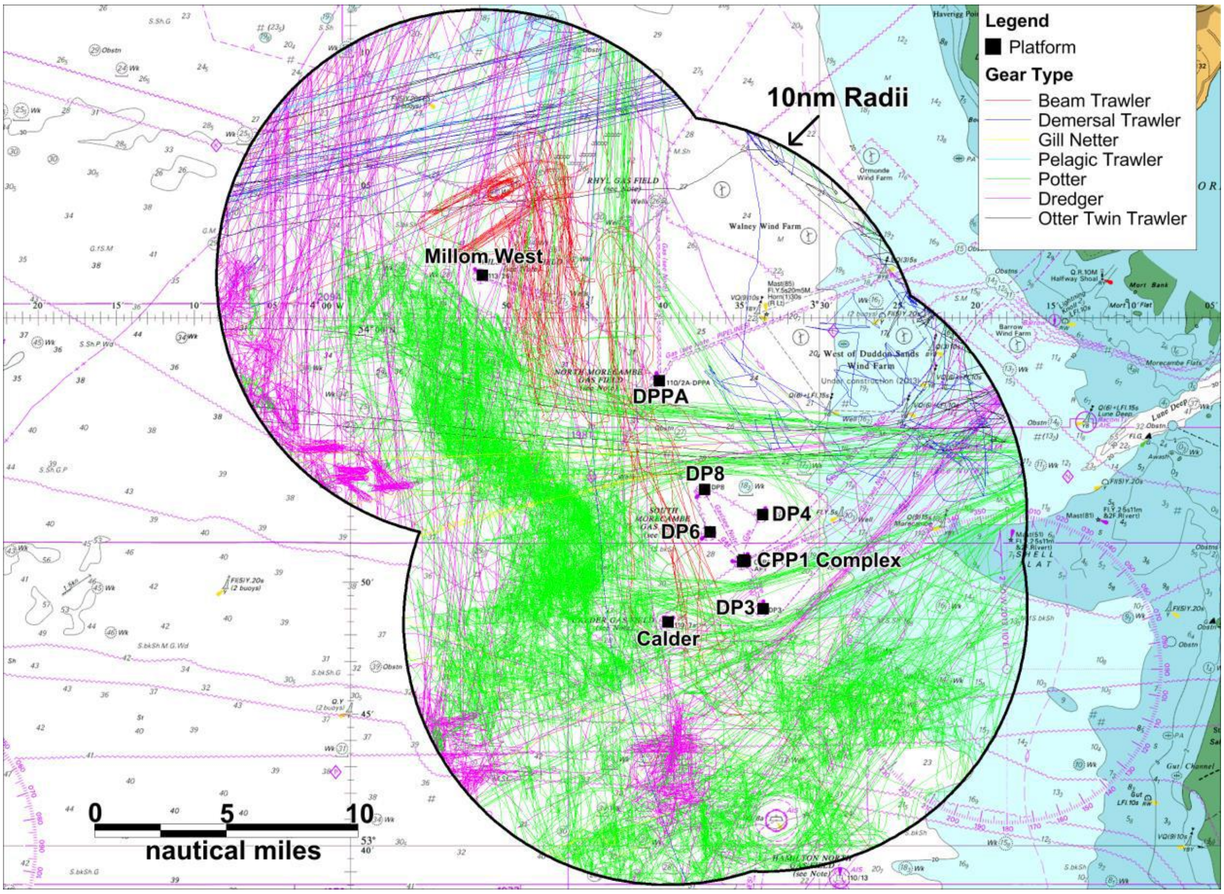

Figure 6.4.2: Fishing vessels within 10nm of the Morecambe platforms by gear type [4]

6.4.2 Oil and gas activities

DP3 and DP4 are in a well-established oil and gas production area within the EIS and are part of Spirit Energy's Morecambe Hub (Figure 6.4.3). The Morecambe Hub consists of installations producing from several primarily gas reservoirs and exporting to the Barrow Gas Terminal. To the south, a group of installations owned and operated by Eni in the Liverpool Bay area produce from oil and gas reservoirs.

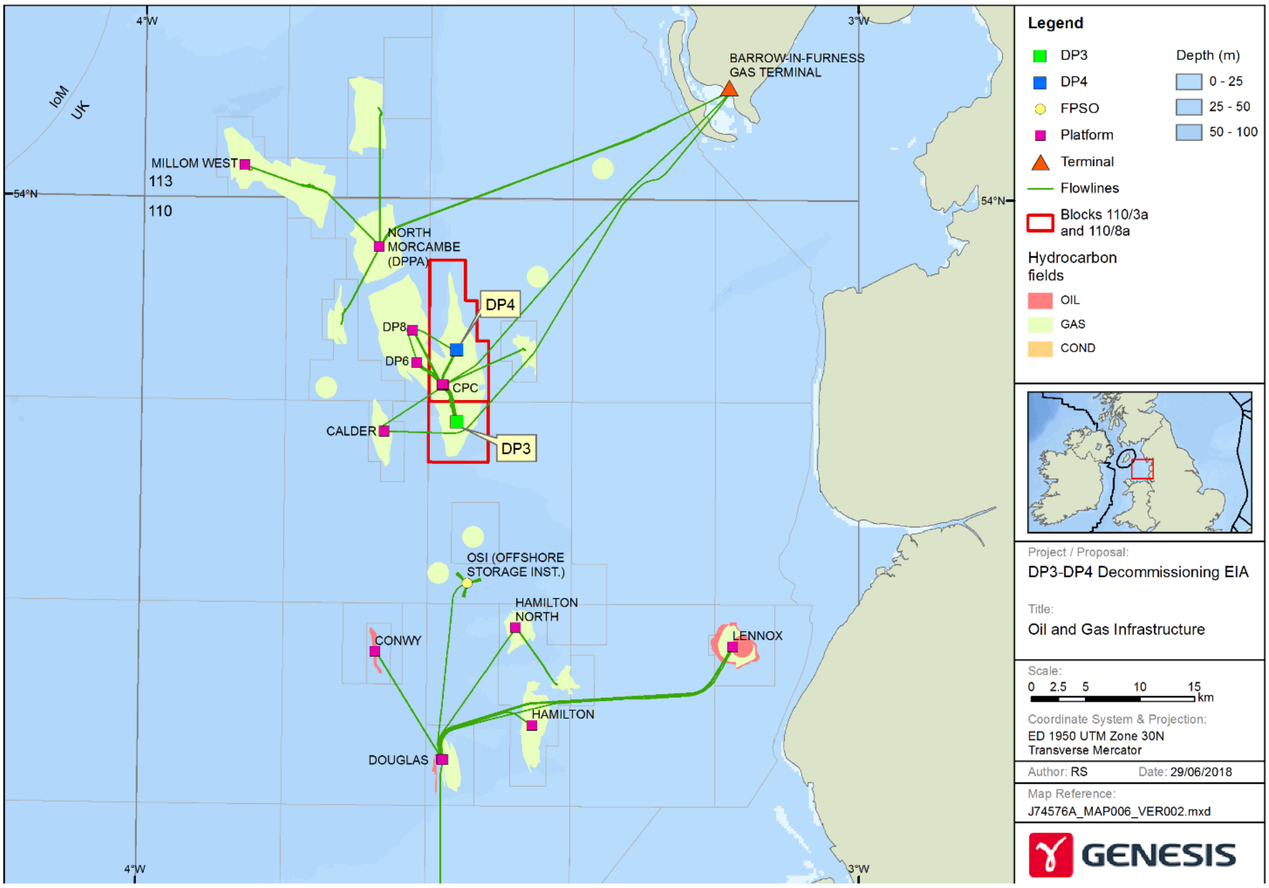

Figure 6.4.3: Established oil and gas infrastructure surrounding Blocks 110/3a and 110/8a

6.4.3 Shipping activities

There are several cargo, tanker, and passenger ferry shipping routes within the EIS. The Oil and Gas Authority (OGA) categorises shipping activity in UKCS licence blocks in terms of vessel density and classifies shipping density in Block 110/3 as 'high' and as 'moderate' in Block 110/8 [72]. The field standby vessel is frequently located close to DP4, and DP3 is located close to fishing vessel activity and to the north of a shipping lane for cargo vessels [4]. Shipping density within 10nm of the DP3 and DP4 platforms is illustrated in Figure 6.4.4.

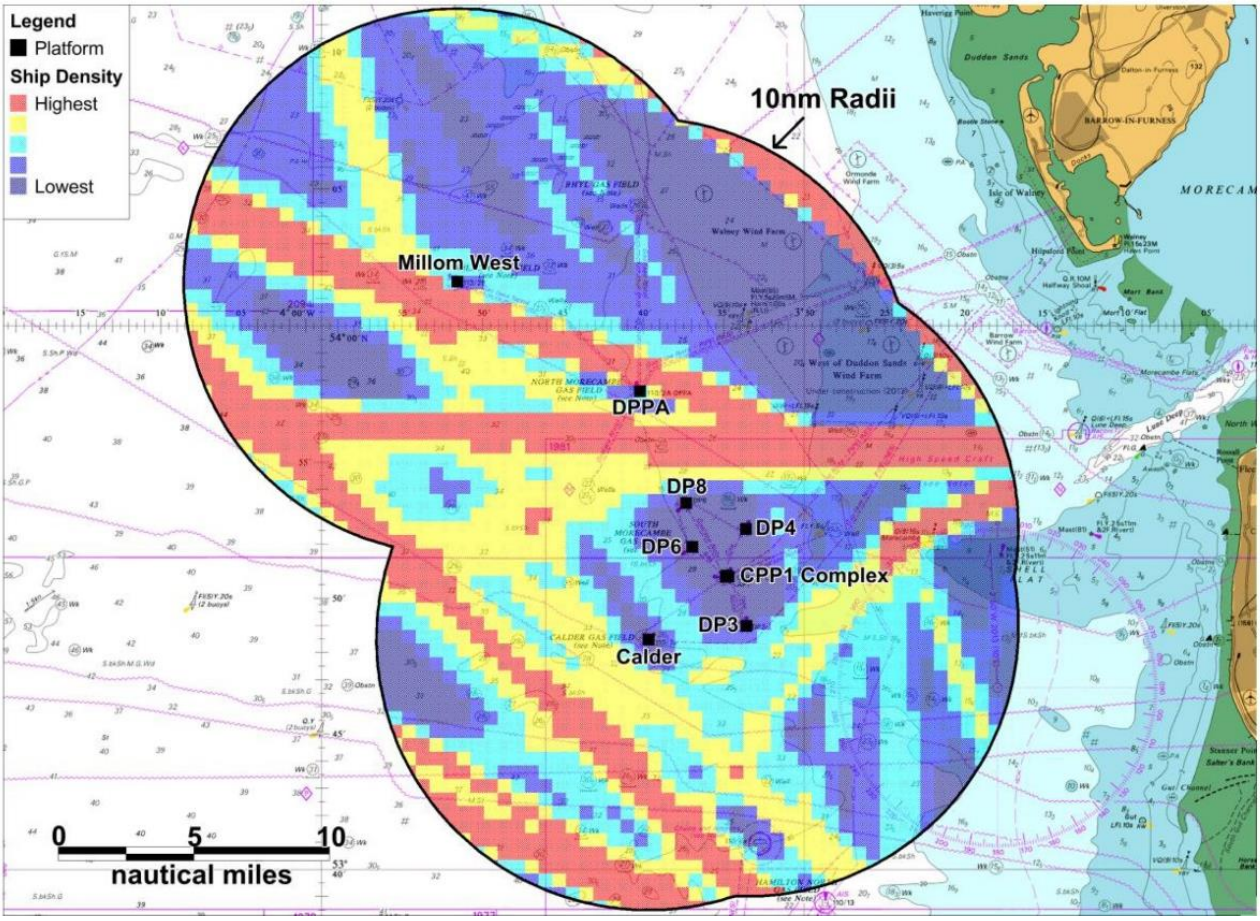

Figure 6.4.4: Shipping route mean positions within 10nm of the Morecambe Hub platforms [4]

6.4.4 Other activities

In addition to fishing, oil and gas production, and shipping, the EIS is host to several other marine industries and activities. These include offshore wind farm development; marine aggregate extraction; submarine power and communication cables; and military exercise areas. The locations of these activities and related infrastructure within the EIS are illustrated in Figure 6.4.5. Table 6.4.2 summarises those located closest to DP3 and DP4.

ACTIVITY	APPROXIMATE DISTANCE (km)	DESCRIPTION
Submarine Cables	3.5	The nearest power cable is the Bispham IoM Electrical Interconnector, located approximately 3.5km northeast of DP4. The nearest
Offshore Renewable Energy	9.2	There are several offshore wind farms at different stages of the consenting process in the EIS, the closest being the operational West of Duddon Sands wind farm located approximately 9km north of DP4.
Marine Aggregate Extraction	16.6	Approximately 16km to the south of DP3, marine aggregates are extracted from licence area 457 (Liverpool Bay) and further to the south, from Licence Area 392 (Hilbre Swash). There is also an exploration and option area (Area 518) 33km to the south of DP4.
Military Activities	27	The nearest UK military Practise and Exercise Area, the Eskmeals military firing range (D406), is located 27km north of DP4.

Table 6.4.2: Summary of 'other activities' in relation to DP3 and DP4

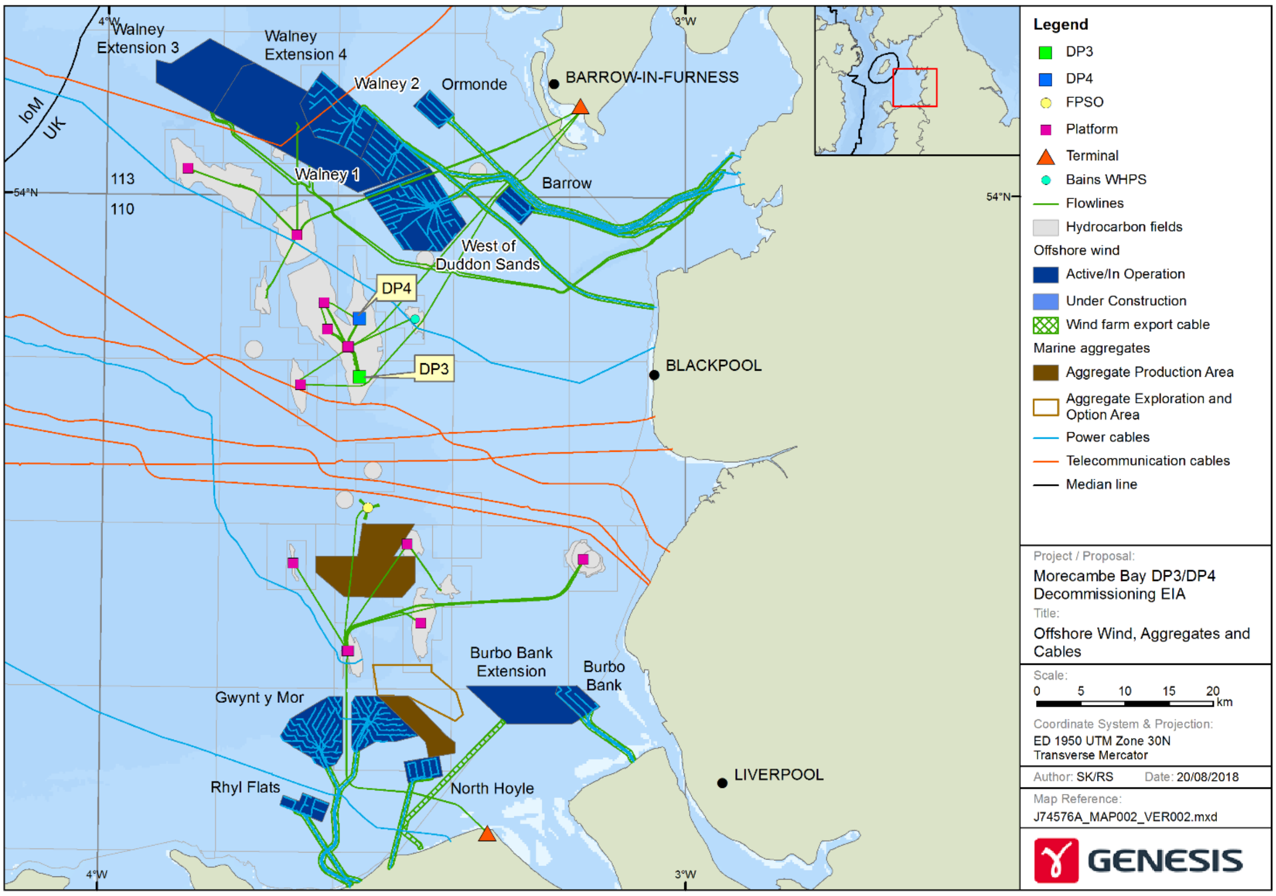

Figure 6.4.5: Offshore wind, aggregates and cables in the vicinity

6.4.5 Cultural heritage

There are no known cultural heritage features within the vicinity of DP3 or DP4. The nearest protected wreck site, designated under the Protection of Wrecks Act (1973), is the Resurgan, an early Victorian submarine, located approximately 47km south of DP3 in Liverpool Bay. The nearest site protected by the Military Remains Act (1986) is approximately 110km away to the southwest of Anglesey [105].

7. DETAILED ENVIRONMENTAL ASSESSMENT

Project aspects were identified, and the associated environmental impacts and risks initially assessed during a workshop (Section 5). The following aspects were categorised as potentially having impacts of 'medium' significance, and were therefore selected for detailed assessment:

- Seabed Disturbance; and,
- Large Hydrocarbon Releases.

7.1 Seabed Disturbance

This section identifies and assesses the impact of the various sources of planned seabed disturbance resulting from the decommissioning activities. Following the adoption of appropriate control and mitigation measures, residual impacts are assessed in the context of the sensitivity, and the attenuating capacity, of the receiving environment.

For the purposes of decommissioning environmental assessments, seabed disturbance can be classified as either 'temporary' or 'permanent'. Temporary disturbance in this context is defined as the impacts arising from the range of activities connected with the removal and recovery of infrastructure; permanent disturbance is defined as the impacts arising from the *in situ* decommissioning of infrastructure.

The bottom sections of the jacket foundation piles, buried sections of pipelines and cables, and areas of pipeline rock cover are the only items that will be decommissioned *in situ*. Given that the cutting of the jacket piles will take place at approximately 1m below the natural seabed, and that pipeline and cable sections decommissioned *in situ* are sufficiently buried and stable, it is not considered that any impact at the seabed will occur, even over an extended period, detailed assessment of these impacts has not been deemed necessary. Existing areas of pipeline rock cover will remain exposed on the seabed and will cause permanent disturbance.

Temporary disturbance from decommissioning activities can result in both direct impacts (e.g. crushing or physical abrasion of benthos) and in indirect impacts (e.g. interference with the respiration or feeding mechanisms of benthos related to increased turbidity and/or smothering).

7.1.1 Sources

The principal planned decommissioning activities, including their location and estimated duration, are described in Section 4. Of these, the use of vessels, the excavation of sediments, the removal of infrastructure, the temporary deposit of objects on the seabed, and the potential overtrawl assessment, have been identified as warranting further assessment in terms of their potential to disturbance of the seabed.

Vessels

Vessels have the potential to disturb the seabed directly by the deployment of anchors, and indirectly due to the wash from propulsion and dynamic positioning systems disturbing the seabed and mobilising sediments. The potential for indirect disturbance will depend upon vessel draught, vessel operating mode and the water depth.

The HLV has yet to be selected but as a worst case, it is assumed that 12 anchors will be used to hold the HLV on location and these will be connected via anchor lines measuring approximately 1.5km each in length and positioned up to approximately 1.2km from the HLV. It is assumed that approximately 500m of each anchor line will be in contact with the seabed, disturbing a corridor with a maximum width of approximately 10m. For the purposes of this EA, it is assumed that the anchors have a 'footprint' of approximately $2m^2$. This assessment assumes that the HLV will be required in four separate locations.

Excavation

The degree of seabed disturbance will be related to the required number of pipeline and cable disconnections, the extent to which each location is initially buried with sediment; and the length of pipeline and cable sections being removed. The pipeline and cable ends will be disconnected at the point at which they reach full burial depth, approximately 1m below natural seabed. Local excavation of sediment will be required to expose the pipelines and cables and enable access (refer to Figure 4.3.1 and Figure 4.3.2). This will create an area of deposited spoil around the excavated trench. Seabed disturbance from excavations is included in the area disturbed by the removal of infrastructure (Table 7.1.1).

Removal of infrastructure

The degree of seabed disturbance will be related to the size ('footprint') of the installations, pipelines, cables and protection and stabilisation features being removed, and the extent to which they are buried by sediment prior to lifting.

Of the infrastructure to be removed, the DP3 and DP4 jackets have the second largest footprint (Table 7.1.1). However, the jacket footprints have been conservatively calculated as the entire area within the jacket legs at the seabed. At seabed level the jackets have bracing around the circumference of the structure, but no internal bracing structures (Figure 2.1.3). Therefore, much of the seabed within the jacket footprints will not be directly impacted be removal. The sections of pipeline and cable that will be removed have the largest footprint (Table 7.1.1).

Temporary seabed deposits

Items may be temporarily deposited on the seabed to facilitate, for example, the batch lifting of infrastructure, tools and equipment. The degree of seabed disturbance caused will be related to the number of items deployed and their size ('footprint'). All temporary deposits will be placed within a 10m corridor around infrastructure decommissioning activities, and within a 500m radius of the platforms. Therefore, associated seabed disturbance will be within the area disturbed by infrastructure decommissioning and the overtrawl assessment (Table 7.1.1). The temporary deposit of anchors will disturb the seabed outside the platform 500m safety zones. This is considered under vessel impacts.

Permanent seabed deposits

It is estimated that up to a maximum of 75Te of small granular rock may be required, as a contingency, to:

- To ensure the edges of bitumen mattresses within the existing footprint of deposited rock will remain buried. Up to 15Te in each of four locations may be required;
- To ensure that the cut pipeline and cable ends will remain buried. In this case, the quantity of rock required is included within the estimated quantity required for ensuring that the edges of the bitumen mattresses remain buried;
- To ensure that PL2718 will remain buried should the concrete mattresses be removed. It is estimated that up to 15Te would be sufficient for the remedial work associated with this activity.

The degree of seabed disturbance caused will be related to the footprint of any deposited rock. However, any additional disturbance will be negligible given it will be predominantly within the footprint of the existing rock cover and bitumen mattresses that will be decommissioned *in situ* and is therefore not assessed further.

If exposed, the mid-line mattresses on PL2718 will be recovered to shore. Following this, should it be considered that the cable would present a snagging hazard prior to the clean seabed verification assessment, as a contingency measure the cable may either need to be retrenched and buried or a small quantity – up to 15Te of deposited rock may be required to protect the cable. To this end, it is assumed that the area of seabed affected will be similar for whichever contingency measure is implemented. Based on this assumption and the fact only one measure will be undertaken, only the area of seabed impacted permanently from the deposition of rock has been calculated and presented in Section 7.1.1.2.

Overtrawl assessment

Upon completion of decommissioning operations, and following recovery of any seabed debris, a seabed clearance survey will be completed. This will confirm that the seabed is free of snagging hazards and safe for fishing. The impact assessment is based on an overtrawl assessment using towed demersal fishing gear typically used in the area. Overtrawl surveys may cover the seabed area within a radius of 500m from the locations of DP3 and DP4 and a 100m corridor along pipeline and cable routes. Spirit Energy will explore the possibility of reducing the trawled area, or use of SSS instead of fishing gear, to minimise seabed disturbance.

Unplanned activities and events

During all lifting activities, there is the potential for infrastructure, tools and equipment to be accidentally dropped because of procedural failure, or mechanical failure of lifting apparatus. The degree of disturbance would be primarily related to the size of the dropped object and its 'footprint'.

Decommissioning of infrastructure *in situ*

The *in situ* decommissioning of pipeline rock cover can be considered to cause permanent disturbance to the seabed. The degree of disturbance will be related to the footprint of the rock cover and the burial status.

7.1.1.1 Temporary disturbance

The principal sources of temporary seabed disturbance, with corresponding maximum area estimates, are itemised in Table 7.1.1 where the total estimated area of seabed disturbance is calculated to be 3.6395km^2 (363.9 hectares). The area disturbed is dominated by the overtrawl assessment, illustrated in Figure 7.1.1. To put this into context, a standard UKCS licence block covers approximately 200km^2. The area impacted is therefore considered small.

SOURCE OF SEABED DISTURBANCE	ASSUMPTIONS MADE	AREA IMPACTED (km^2)
VESSELS		
Deployment of HLV anchors and anchor lines	Based on 12 anchors and four HLV positions, two at each platform. Assumes the area of disturbance when positioning the anchors is 10m x 10m and a maximum length of 500m of each anchor line impacts the seabed across a 10m corridor width.	0.2448
REMOVAL OF INFRASTRUCTURE		
Removal of pipeline and cable ends**	DP3: PL195, PL205, PL2718; cable IF-07E13. DP4: PL194, PL204; cables IF-07E41, IF-07E84. CPP1: PL194, PL195, PL204, PL205, IF-07E41, PL2718' DP8: IF-07E84. Total length of pipelines and cable ends** to be recovered is up to 1.40km. The area of seabed disturbance is assumed to be a 10m corridor, allowing for excavation of sediment. Dimensions impacted under this campaign: Length 0.70km; Area: 0.007km^2	0.0140*
Removal of anti-scour support ramps	DP3 has two ramps (1 x Type 1, 1 x Type 2) DP4 has one ramp (1 x Type 2) Type 1: 19.0m x 1.1m = 20.9m^2 Type 2: 20.8m x 3.6m = 74.9m^2 Anti-scour support ramps will be disconnected from the jacket structures and deposited on the seabed before being recovered. An additional 5m has been added to the measurements to allow for disturbance beyond	0.0006*

SOURCE OF SEABED DISTURBANCE	ASSUMPTIONS MADE	AREA IMPACTED (km^2)
	the exact dimensions of each structure. Total footprint of ramps = 0.0002km^2	
Removal of DP3 and DP4 jackets	The DP3 jacket measures 46.6m x 46.6m at the seabed. The DP4 jacket measures 43.2m x 43.2m at the seabed. Leg skirt piles extend beyond the base of the jacket legs. However, an additional 5m has been added to the jacket base measurements to allow for disturbance beyond the exact dimensions of each structure. Total footprint of jackets = 0.0037km^2.	0.0046*
Removal of mattresses and grout bags	DP3 has 51 mattresses (22 bitumen, 29 concrete) and approximately 28 grout bags. 15 bitumen mattresses are buried under rock and will not be removed. DP4 has 29 mattresses (22 bitumen, 7 concrete) and 28 grout bags. 15 bitumen mattresses are buried under rock and will not be removed. CPP1 has 65 mattresses (51 bitumen, 14 concrete) and 106 grout bags associated with DP3 and DP4 pipelines and cables. 35 bitumen mattresses are buried under rock and will not be removed. DP8 has 16 concrete mattresses and 50 grout bags associated with DP3 and DP4 pipelines and cables. There are a further 5 concrete mattresses midline on PL2718. Total net footprint of mattresses and grout bags = 0.0016km^2. Net area impacted under this campaign: 0.0009km^2 Gross area impacted under this campaign: 0.0023km^2	0.0042*
OVERTRAWL ASSESSMENT		
Overtrawl assessment	Two HSE 500m safety zones (1.5708km^2). Pipelines overtrawl (1.82391km^2)	3.3947
Total (accounting for overlap)		**3.6395**

NOTES:

Under this campaign only pipeline and cable ends at DP3 and DP4 will be decommissioned. At CPP1 and DP8 the pipeline and cables ends will be decommissioned at the same time as the respective platforms.

Gross area impacted is equal to net area plus a 2m allowance for disturbance around the perimeter of the mattresses and grout bags.

* The mattresses and grout bags are positioned over and under the pipelines and cables. Pipeline and cable ends, platform jackets and anti-scour support ramps are all within the overtrawl assessment area. To avoid double counting, these areas are not included in the calculated total.

** Ends are defined as sections of pipeline or cable that make the transition from full burial to the seabed surface, and those that rest on the seabed.

Table 7.1.1: Estimated area of temporary seabed disturbance

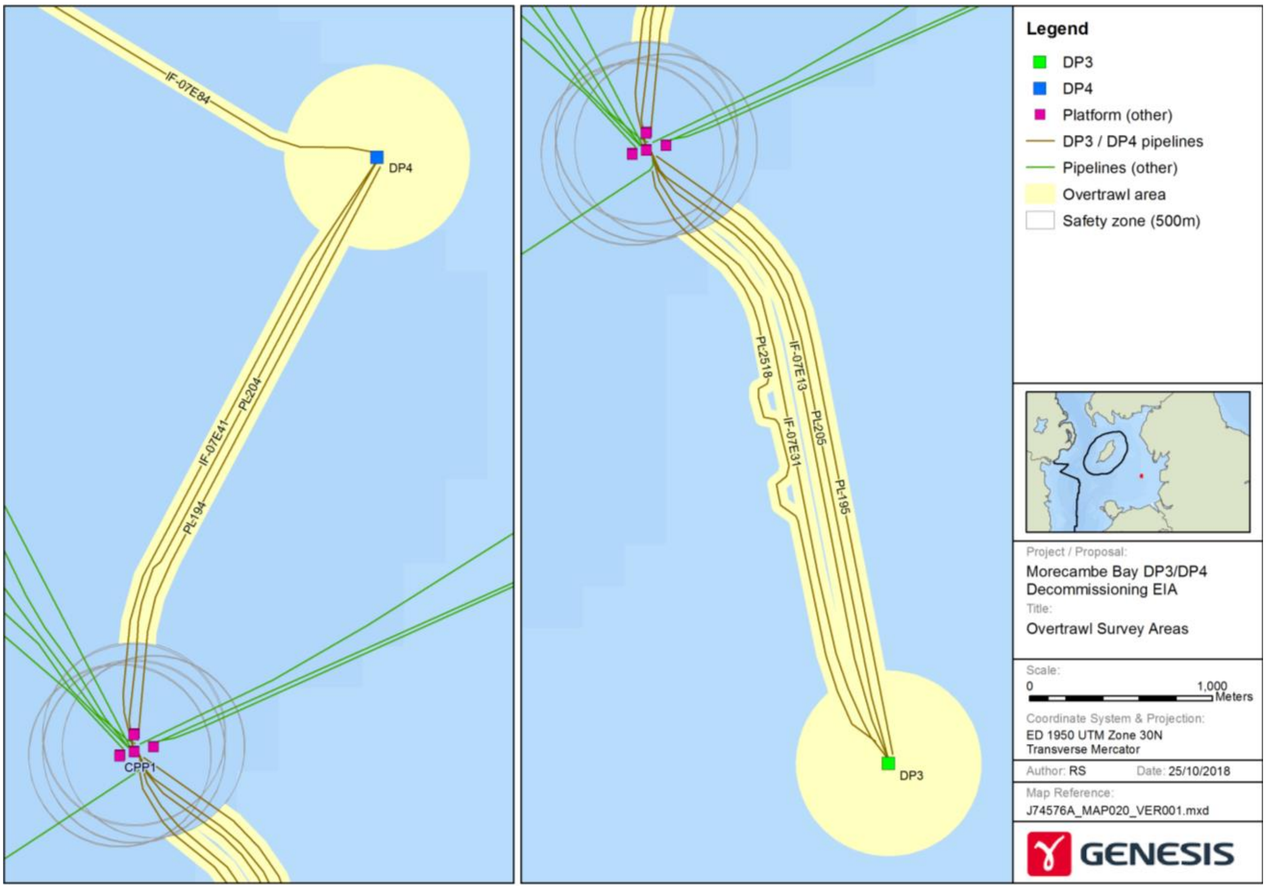

Figure 7.1.1: Overtrawl area

7.1.1.2 Permanent disturbance

The principal source of permanent seabed disturbance is from the decommissioning of existing pipeline rock cover *in situ* which is largely exposed on the seabed. Sixty-five bitumen mattresses are buried under this rock and will not be removed. Any rock used for contingency remedial works will be deposited within the footprint of the existing rock cover. If exposed, the mid-line mattresses on PL2718 will be recovered to shore. Following this, should it be considered that the cable would present a snagging hazard prior to the verification overtrawl, as a contingency measure the cable may either be retrenched and buried or a small quantity of deposited rock (up to 15Te) may be required to protect the cable. The estimated area of permanent disturbance from depositing rock on the cable is 0.00003 km^2 (an area of approximately 30m x 1m). The remaining jacket leg piles, pipelines and cables decommissioned *in situ* are buried and are expected to remain below seabed level. Pipeline rock cover is located on:

- PL195 approach to DP3 (approximately 200m x 12m);
- PL195 approach to CPP1 (approximately 200m x 12m);
- PL194 approach to DP4 (approximately 200m x 12m); and,
- PL194 approach to CPP1 (approximately 200m x 12m).

The estimated total area of permanent disturbance is 0.00963km^2. To put this into context, a licence block is approximately 200km^2. The area impacted is therefore considered small.

7.1.2 Impacts and receptors

The removal of infrastructure (including excavation), the temporary deposit of tools and equipment, the conduct of any overtrawl survey, the use of anchors and anchor lines by the HLV, and the decommissioning of pipelines, cables and associated protection and stabilisation features all have the potential to cause a range of direct and indirect impacts.

Available information suggests that the seabed in the area is likely to be characterised by fine sediments consisting mud and sand, or clayey sandy silt. There are areas of gravel with sand patches within approximately 50m of DP3 and DP4, possibly as a result of scour [27], [28]. Environmental surveys of the DP3 and DP4 locations will be completed before decommissioning activities commence. This assessment is based on available information for the area summarised in Section 6.1.3.

7.1.2.1 Temporary disturbance

7.1.2.1.1 Direct impacts

The crushing and physical abrasion of benthos under temporarily deposited items, by anchors and their lines, by demersal fishing gear, and the abrasion of benthos during infrastructure removal (including excavation); or forcible relocation during the deployment of anchor lines or demersal gear; may result in mortality or in physical injury. The significance of impact will depend upon the number and type of species present, including their ability to move away from the area of operations.

Based on existing information, the characteristic seabed in the area is most likely to be circalittoral sandy mud (SS.SMu.CSaMu), possibly the *Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud biotope (Section 6.2.2). Characterising species of the biotope are infauna that have some protection against surface disturbance. However, bivalves and other species require contact with the surface for respiration and feeding, so siphons and delicate feeding structures may be damaged [18]. Brittlestars can resist considerable damage without suffering mortality, suggesting that they may be less susceptible to damage than other species ([89], [83]). However, a proportion of the benthic population is likely to be damaged or removed, and muddy sands were found to be vulnerable to the impacts of fishing activities, with full recovery within two to ten years if a significant proportion of the seabed fauna in the impacted area is removed ([53], [18]). It is considered that a receptor has recovered when approximately 80% of the damage has been rectified [93]. Against this criterion, the benthos would be expected to recover in less than 3 years depending on the rate of recruitment by immigration or larval recruitment.

The area of seabed that will be affected, primarily within the platform 500m safety zones, represents only a very small proportion of the biotope in the EIS. The significance of the impacts associated with direct seabed disturbance on benthos has therefore been assessed as **medium**.

As discussed in Section 6.2.3, several species of fish are known to spawn within the vicinity of DP3 and DP4, with other species using it as a nursery area. Adult and juvenile fish will move away from direct disturbance. *Nephrops* and sandeels burrow in to the seabed, and sandeels also deposit their eggs on the seabed, making them potentially vulnerable to mortality or physical injury. However, the seabed in the vicinity is not expected to be suitable for these species. Even if they are present, in comparison to the extent of suitable habitat in the Irish Sea, the area of seabed directly disturbed is very small. The significance of the impacts associated with direct seabed disturbance on fish has therefore been assessed as **low**.

The DP3 and DP4 infrastructure in relation to the Liverpool Bay/Bae Lerpwl SPA is shown in Figure 7.1.2.

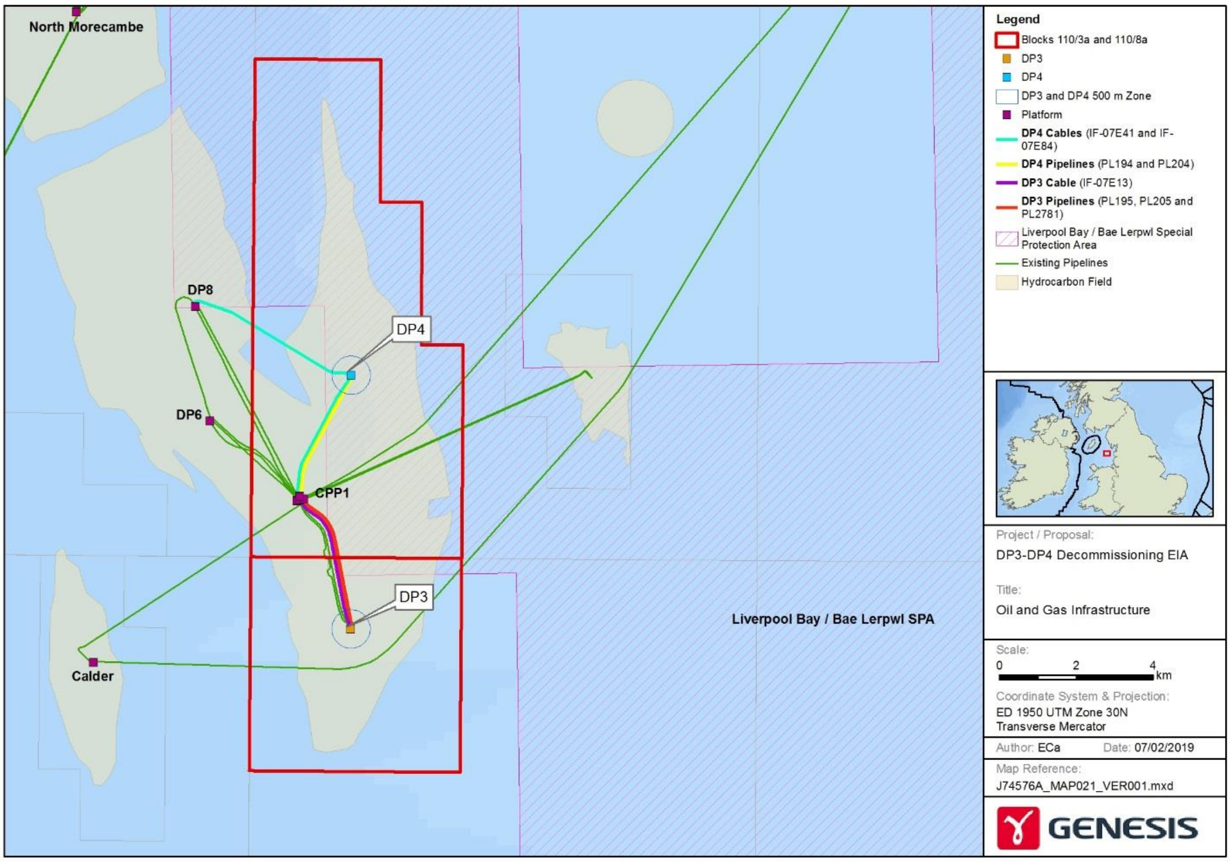

Figure 7.1.2: DP3 and DP4 infrastructure in relation to the Liverpool Bay/Bae Lerpwl SPA

The sources of temporary seabed disturbance that will occur in the Liverpool Bay/Bae Lerpwl SPA site (Figure 7.1.2) with corresponding maximum area estimates, are itemised in Table 7.1.2.

SOURCE OF SEABED DISTURBANCE	ASSUMPTIONS MADE	AREA IMPACTED (km^2)
VESSELS		
Deployment of HLV anchors and anchor lines	Based on 12 anchors and two HLV positions. Assumes the area of disturbance when positioning the anchors is 10m x 10m and a maximum length of 500m of each anchor line impacts the seabed across a 10m corridor width.	0.1224
REMOVAL OF INFRASTRUCTURE		
Removal of pipeline and cable ends**	DP4: PL194, PL204; cables IF-07E41, IF-07E84. DP8: cables IF-07E84. Total length of pipelines and cable ends** to be recovered is up to 0.515km. The area of seabed disturbance is assumed to be a 10m corridor, allowing for excavation of sediment. Dimensions impacted under this campaign: Length 0.255km; Area: 0.0026km^2	0.0052*
Removal of anti-scour support ramps	DP4 has one ramp (: 20.8m x 3.6m = 74.9m^2) The anti-scour support ramp will be disconnected from the jacket structure and deposited on the seabed before being recovered. An additional 5m has been added to the measurements to allow for disturbance beyond the exact dimensions of each structure. Total footprint of ramp = 0.00007km^2	0.00022*
Removal of DP4 jacket	The DP4 jacket measures 43.2m x 43.2m at the seabed. Leg skirt piles extend beyond the base of the jacket legs. However, an additional 5m has been added to the jacket base measurements to allow for disturbance beyond the exact dimensions of each structure.	0.0023*
Removal of mattresses and grout bags	DP8 has 16 concrete mattresses and 50 grout bags associated with DP3 and DP4 pipelines and cables. DP4 has 29 mattresses (22 bitumen, 7 concrete) and 28 grout bags. 15 bitumen mattresses are buried under rock and will not be removed. The remaining 18 mattresses will be recovered along with all exposed grout bags. Net area impacted under this campaign: 0.0002km^2 Gross area impacted under this campaign: 0.0006km^2	0.0012*
OVERTRAWL ASSESSMENT		
Overtrawl assessment	HSE 500m safety zone (0.7854km^2). Pipelines overtrawl (0.7275km^2)	1.5129
Total (accounting for overlap)		**1.6353**
NOTES: Under this campaign only pipeline and cable ends at DP3 and DP4 will be decommissioned. At CPP1 and DP8 the pipeline and cables ends will be decommissioned at the same time as the respective platforms. Gross area impacted is equal to net area plus a 2m allowance for disturbance around the perimeter of the mattresses and grout bags. * The mattresses and grout bags are positioned over and under the pipelines and cables. Pipeline and cable ends, platform jackets and anti-scour support ramps are all within the overtrawl assessment area. To avoid double counting, these areas are not included in the calculated total. ** Ends are defined as sections of pipeline or cable that make the transition from full burial to the seabed surface, and those that rest on the seabed.		

Table 7.1.2: Area of temporary seabed disturbance within the Liverpool Bay/Bae Lerpwl

The area of seabed within the Liverpool Bay/Bae Lerpwl SPA that could potentially be disturbed has been calculated as 1.6353km^2 (Table 7.1.2). However, Spirit Energy will aim to reduce this area by using non-invasive techniques such as SSS for post-decommissioning assessment along the pipelines. Given the area of disturbance is small relative to the overall site (0.06%); the site is designated for the presence of birds and not seabed features; and the seabed within the vicinity of DP4 is not expected to be suitable for sandeels, a prey species for some of the birds for which the site is designated, the significance of the impacts associated with direct seabed disturbance on the Liverpool Bay/Bae Lerpwl SPA has been assessed as **low**.

Overall, the significance of the impacts associated with direct seabed disturbance has been assessed as **medium**.

7.1.2.1.2 Indirect impacts

The ejection or emission of sediment into the water column associated with the project activities discussed in Section 7.1.2.1.1 will result in temporarily increased suspended solids concentrations, and where redeposition occurs, subsequent changes to the physical - and potential changes to the chemical - characteristics of the seabed.

The scale of impact will depend upon the nature of the sediment being redistributed and the sedimentary characteristics of the area where it is redeposited, and the abundance of type of benthos present, including their ability to move away from the area of operations, and resilience to increased water column turbidity or smothering.

The geographic extent of sediment mobilisation from seabed disturbance close to the platforms is likely to be limited by the presence of areas of gravel with sand patches. This coarse sediment will not disperse far. However, disturbed fine sediments will be distributed across a wider area. Although not found in high energy environments, the benthos found in circalittoral sandy mud is likely be exposed to periodic disturbance from moderately strong currents and wave action [67]. Scoured areas around the platform jackets, the absence of historical drill cuttings piles, and megaripples observed around the DP3 platform are evidence of seabed sediment transport ([27], [28]).

The biotope is characterised by burrowing species that are likely to be able to burrow upwards and are therefore unlikely to be adversely affected by light smothering [18]. *Ophiura ophiura* is highly tolerant of short term (32 days) burial events, with less than 10% mortality [57]. Bivalve and polychaete species have been reported to migrate through depositions of greater than 30cm of fine sediment ([82], [66]). Therefore, the characterising species are likely to be able to tolerate burial, although some mortality may occur in areas of greatest sediment redeposition. Outside these areas, an increase in the suspended matter settling out from the water column may increase food availability [18].

Impacts from exposure to contaminants as a result of sediment mobilisation and redeposition are unlikely because the benthic community present in muddy sands is dominated by burrowing infauna that are naturally exposed to any contamination in the sediment. No cuttings piles exist at DP3 and DP4 and historical drilling did not discharge any oil based mud. Site specific information about sediment chemistry and potential contaminants will be obtained as part of the pre-decommissioning environmental survey, and results will be included in subsequent execution phase permit applications.

The significance of the indirect impacts associated with seabed disturbance on benthos has therefore been assessed as **low**.

Increased suspended solids concentrations and sediment redeposition is unlikely to affect fish species that are broadcast spawners because they release the eggs and sperm into the water column, after which they are widely dispersed. Sediment redeposition has the potential to impact spawning grounds for species that lay their eggs on the seabed (demersal spawners), which include herring and sandeel. However, as discussed in Section 6.2.3, available information suggests that the seabed around DP3 and DP4 is not suitable for sandeel or herring spawning. The significance of the impacts associated with direct seabed disturbance on fish has therefore been assessed as **low**.

Overall, the significance of the indirect impacts associated with seabed disturbance has been assessed as **low.**

7.1.2.2 Permanent disturbance

Permanent seabed disturbance from infrastructure decommissioned *in situ*, itemised in Section 7.1.2.2, can lead to long term impacts to seabed habitats dynamics and changes to the benthic fauna. Any rock used for contingency remedial works to make sure the edges of the already buried bitumen mattresses are not exposed will be deposited within the footprint of the existing rock cover.

Under the DP3 and DP4 Decommissioning Programmes, up to approximately 0.0096km^2 of rock cover, decommissioned *in situ*, will remain exposed on the seabed. Approximately 0.0024 km^2 of rock cover, decommissioned *in situ*, will remain exposed on the seabed within the Liverpool Bay/Bae Lerpwl SPA. Given the area of rock cover is small relative to the overall SPA site (0.000095%) the significance of the impacts associated with permanent seabed disturbance on the Liverpool Bay/Bae Lerpwl SPA has therefore been assessed as **low**.

In addition, any rock used as a contingency for burial of cable PL2718 will equate to a footprint of approximately 0.00003 km^2 and will remain exposed on the seabed. The footprint of the deposited rock for burial of cable PL2718 would not fall within the area of the Liverpool Bay/Bae Lerpwl SPA and therefore no impact on this site is anticipated. This introduced hard substrate with limited sediment cover will remain as a habitat within the circalittoral rock classification, colonised by an associated benthic community, which would otherwise not be present in the area.

The area of permanent seabed disturbance relative to the extent of the identified circalittoral sandy mud habitats in the EIS is small. Therefore, the significance of the impacts associated with permanent seabed disturbance been assessed as **medium**.

7.1.3 Cumulative and transboundary impacts

The worst case cumulative area of directly disturbed seabed, due to planned and ongoing activities but excluding fishing, within a 40km radius of DP3 or DP4 is shown in Table 7.1.3. The nearest planned activity that will result in seabed disturbance is the decommissioning of the Bains gas field located, 6.3km to the east of DP4 (Block 110/3c). Bains comprises a single well subsea tie-back to CPC. Decommissioning is estimated to involve, as a worst case, the temporary disturbance of 1.884km^2 of seabed, primarily from overtrawl assessment, and permanent disturbance from the decommissioning of pipelines and umbilical lines, mattresses and deposited rock *in situ* of up to 0.01522km^2 [95]. There is no other planned seabed disturbance with 10km of DP3 or DP4 except for fishing activity. This is an ongoing source of seabed disturbance. However, it is difficult to quantify the area impacted by fishing gear. Information presented in Section 6.4.1 suggests that fishing activity is relatively low near DP3 and DP4, and moderate in the wider area (ICES rectangle 36E6).

Approximately 16.5km to the south of DP3, marine aggregates are extracted from Licence Area 457 (Liverpool Bay) and further to the south, from Licence Area 392 (Hilbre Swash). Within the Liverpool Bay licence area, there are four active dredge zones with a total seabed footprint of 9.938km^2 [12].

ACTIVITY	DISTANCE (km)	AREA IMPACTED (km^2)
Oil and Gas[1]		
DP3 and DP4 decommissioning	0	3.6395
Bains decommissioning [95]	6.3	1.884
Offshore Renewables		
No projects planned or under construction	-	-
Marine Aggregate Extraction (ongoing)[2]		
Licence Area 457 Liverpool Bay	16.6	9.938
Licence Area 392 Hilbre Swash	36.2	21.831
Total		**37.2925**
Seabed area within 40km of DP3 and DP4	**-**	5,026.55

[1] Note that the DP3 and DP4, and Bains values include the overtrawl assessment impacts.
[2] Area impacted is calculated based on active dredge zone [12]. The actual area of seabed dredged in any year will be a fraction of this. In 2016 only 4.8% of total active dredge areas in the northwest of England were dredged [12].

Table 7.1.3: Cumulative temporary seabed disturbance within 40km of DP3 or DP4

The total area of seabed identified within 40km which may experience temporary impacts is 37.29km^2, which comprises 0.7% of the seabed area. The timing of some of these impacts may overlap, but they will not occur in close proximity. Due to the short duration and localised nature of seabed disturbance from the DP3 and DP4 decommissioning activities, no significant cumulative impacts associated with temporary seabed disturbance are anticipated. Similarly, given the small area permanently disturbed by DP3 and DP4 infrastructure decommissioned *in situ*, no significant cumulative impacts associated with permanent seabed disturbance are anticipated.

DP3 and DP4 are located approximately 115km east of the UK/Ireland jurisdictional median line and 42km southwest of Isle of Man territorial waters. Given these distances and the relatively localised impacts, no transboundary impacts associated with seabed disturbance are anticipated.

7.1.4 Control and mitigation measures

The following measures will be adopted to ensure that seabed disturbance and its impacts are minimised to a level that is 'as low as reasonably practicable':

- All activities which may lead to seabed disturbance will be planned, managed and implemented in such a way that disturbance is minimised;
  - If the topsides and jackets are lifted and recovered to shore separately by the HLV, the repositioning of HLV anchors for subsequent lifts will be avoided, if practicable;
  - Lifting operations will be conducted around high tide and slack water to minimise the distribution of mobilised sediments;
  - Lifting operations will be conducted in a controlled manner to minimise mobilisation of sediment; and,
  - If practicable, the HLV will use dynamic positioning instead of anchors at DP3 where water depth is greater.
- A debris survey will be undertaken at the completion of the decommissioning activities. Any debris identified as resulting from decommissioning activities will be recovered from the seabed where possible; and
- The area that requires an overtrawl assessment will be minimised through discussion with the

NFFO and the regulators. Remote sensing techniques will be used if appropriate.

7.1.5 Conclusions

The principal sources of seabed disturbance associated with DP3 and DP4 decommissioning activities concern the positioning of HLV anchors and anchor lines, and the overtrawl assessment. These activities will result in deposits on, and physical abrasion of the seabed, causing direct mortality or physical injury to benthos. Indirect disturbance of sediment will result in increased turbidity and/or smothering of benthos.

Standard measures to control disturbance include operational planning and equipment selection. By minimising the deployment of HLV anchors it may be possible to reduce the area of seabed disturbed by up to 0.1788km^2.

Available evidence suggests that seabed community near DP3 and DP4 is likely to be tolerant to suspension and subsequent settlement of sediment. However, a proportion of the benthic community is likely to be injured or killed by anchor deployment and the overtrawl assessment. Depending on the individual losses in effected areas, full recovery could take several years. However, these species and habitats are relatively widespread throughout the EIS and the area anticipated to be impacted represents a very small percentage of the available habitat.

In summary, due to the localised and relatively short duration of the decommissioning activities, and with the identified control and mitigation measures in place, the overall significance of the impact of seabed disturbance because of the decommissioning of DP3 and DP4 is considered **medium** and ‘as low as reasonably practicable’.

7.2 Large Hydrocarbon Releases

This section identifies the potential sources of large unplanned (accidental) releases to the marine environment in connection with the decommissioning activities and assesses the potential impacts.

Following the adoption of appropriate prevention and response measures, the overall risk of impact presented by identified release scenarios is assessed in terms of probability of occurrence, and the consequences given the sensitivity of, and the assimilative capacity of, the receiving environment.

7.2.1 Sources

The principal planned decommissioning activities, including their location and estimated duration, are described in Section 4. Of these, the use of vessels and the potential for an unplanned large volume release of diesel to sea has been identified as the only activity warranting further assessment in terms of the potential impact on the environment.

Unplanned large volume releases of diesel to sea from vessels could occur because of:

- Loss of structural integrity of storage tanks following a collision with another vessel or fixed facility; and
- Loss of structural integrity of storage tanks following corrosion or mechanical failure.

The worst case in terms of volume and rate of release would be the immediate total loss of the entire diesel inventory to sea. This eventuality is considered highly unlikely (a rare combination of factors would be required for an event to occur) owing to procedural (vessels' management systems) and operational controls that will be applied.

The project vessel expected to carry the largest diesel inventory will be the HLV. Based on a review of the candidate HLVs capable of lifting and removing the DP3 and DP4 topsides and jackets, a maximum diesel inventory of 9,171m^3 has been identified.

Oil spill fate and trajectory modelling

The Morecambe Hub OPEP [40] includes Oil Spill Contingency and Response (OSCAR) modelling describing the potential fate of an instantaneous release of 916.8m^3 of marine diesel in the South Morecambe Field. Additional OSCAR modelling was therefore necessary to understand the consequences of an instantaneous release of the full HLV marine diesel inventory at DP3 [107].

Stochastic modelling involves running a single spill scenario multiple times over different time periods (with different start and end times). This allows for the spill scenario to be modelled during different weather conditions. Results from all the individual stochastic simulations are then aggregated in order to report behaviour in a probabilistic or statistical sense. The stochastic model results that have been utilised in this assessment report are:

- Probability of hydrocarbon above a threshold thickness of 0.3 µm appearing on the sea surface;
- Probability of any hydrocarbon (i.e. no threshold applied) reaching the shoreline; and
- Maximum concentration of hydrocarbon reaching the shoreline.

7.2.2 Impacts and receptors

A surface thickness threshold of >0.3µm is the minimum surface thickness identified by the Bonn Agreement Oil Appearance Code (BAOAC) capable of producing a visible rainbow surface sheen. This threshold value was chosen as that above which potential significant environmental impacts may begin to occur. The probability of surface hydrocarbons of thickness above 0.3µm is modelled to be high (<40%) around the release location and extending north, east and west (Figure 7.2.1). There is some seasonal variation, with hydrocarbons more likely to travel towards the IoM in spring (March to May), towards the north and east in to Morecambe Bay in summer (June to August), and east towards the Lancashire coastline in autumn (September to November).

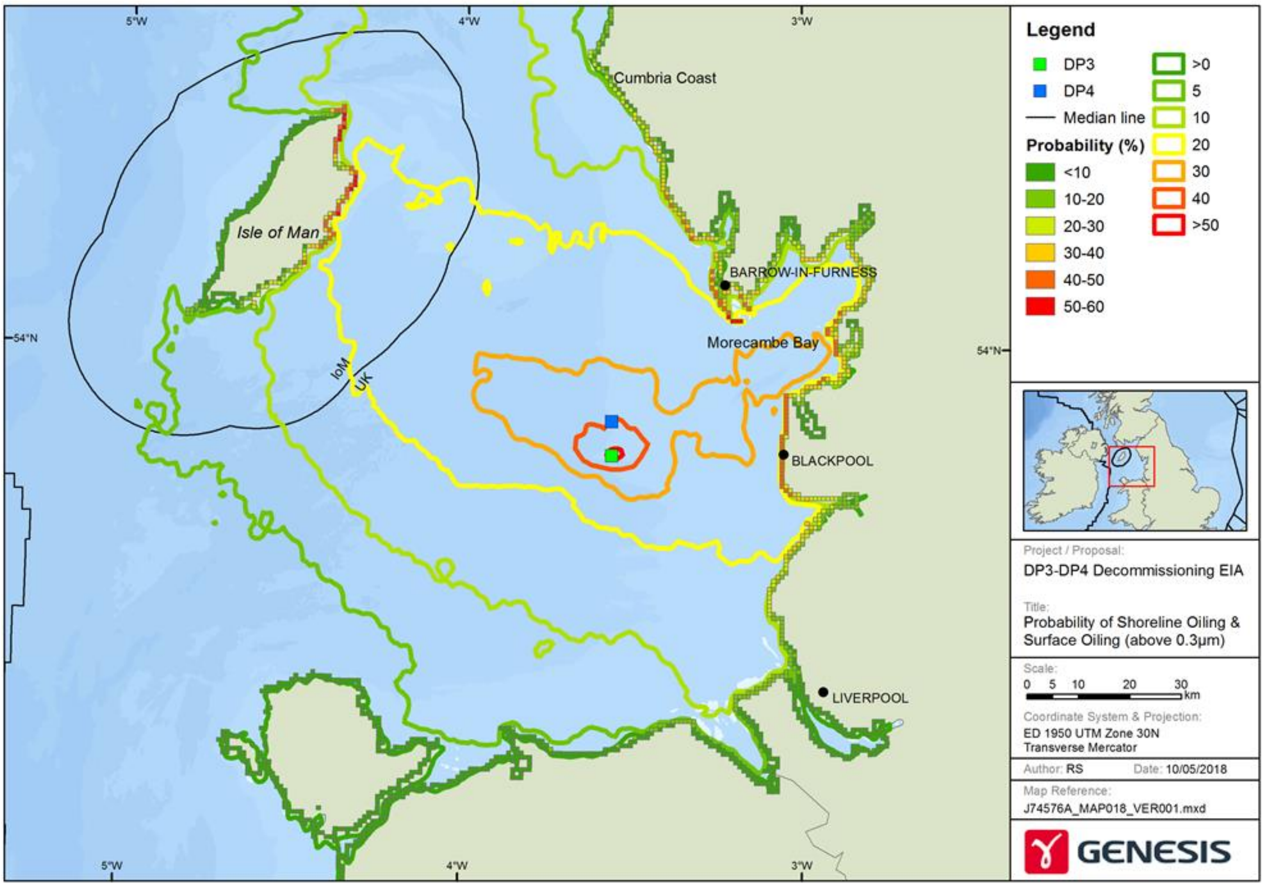

Figure 7.2.1: Probability of shoreline oiling and surface oiling (above 0.3µm)

The maximum probability for shoreline oiling is 61% on the east coast of the Isle of Man. The Lancashire and Cumbria coastlines have a relatively high probability of contamination which is highest in autumn at 54% and 50% respectively (Figure 7.2.1).

Figure 7.2.2 illustrates the fate of the modelled diesel release over a 30-day period. It shows that much of the diesel would quickly evaporate, with 50% evaporated after 13.5 days and 62% (4,950Te) after 30 days [107]. Biodegradation would also remove 18.5% (1,470Te) from the environment after 30 days. Over half of the remainder (13%, 1,030Te) would be incorporated in to sediments and very little diesel would be stranded on the shoreline (5.2%, 418Te) after 30 days [107]. Less than 0.1% (3Te) would be on the sea surface and 1.2% (95Te) dispersed in the water column after 30 days.

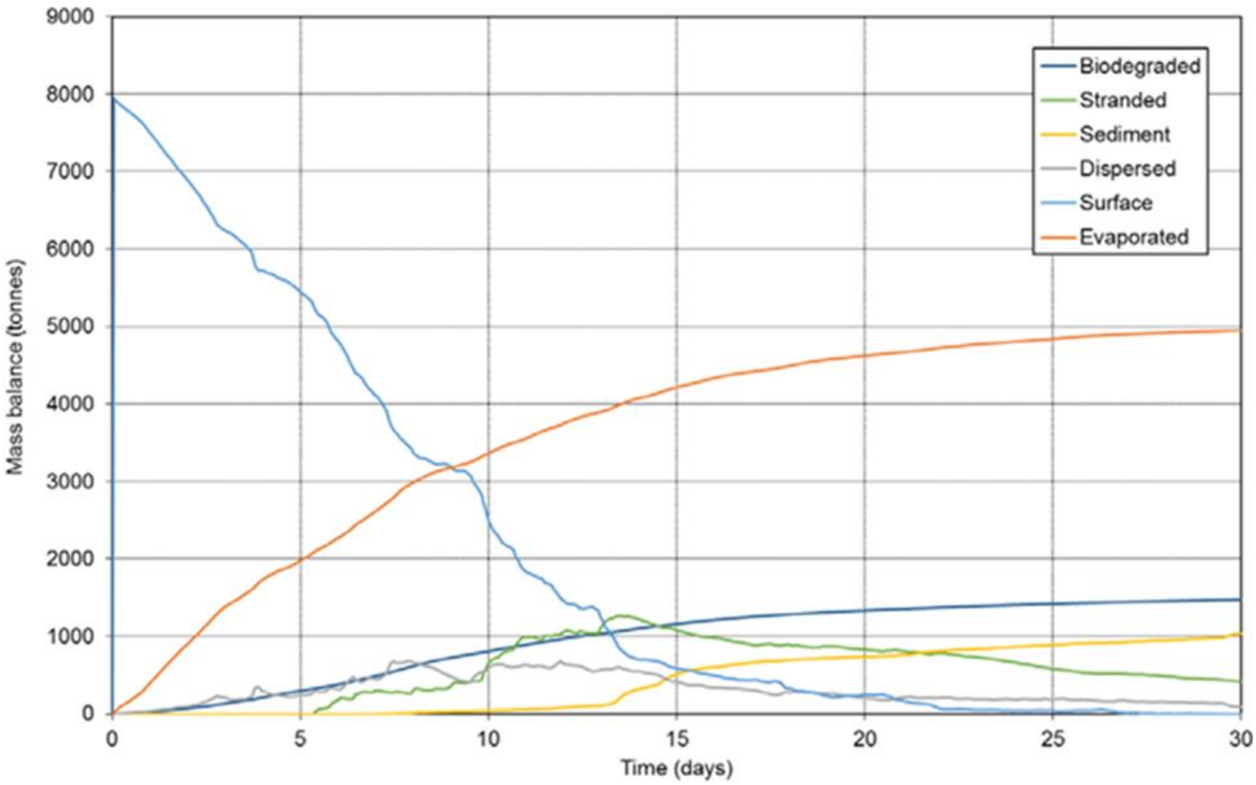

Figure 7.2.2: Fate of diesel over time (Mass balance) [107]

7.2.2.1 Water quality

Diesel will float on the sea surface and be spread over wide areas by wind, waves and currents. It has very high levels of light hydrocarbons and therefore evaporates quickly on release. The low asphaltene content prevents emulsification reducing its persistence in the environment. Low viscosity oils like diesel may disperse naturally within the top few metres of the water column, particularly in the presence of breaking waves, where they are rapidly diluted [47]. After 30 days, 1.2% (approx. 95Te) of the diesel release would remain dispersed in the water phase [107] (Figure 7.2.2).

Therefore, the significance of impacts on water quality from a large hydrocarbon release has been assessed as **low**. Given the low likelihood of such a release, the overall risk of associated impacts on water quality has been assessed as **low**.

7.2.2.2 Seabed and shoreline sediment quality

As discussed in Section 7.2.2.1 above, given the low persistence of diesel in the marine environment and it's reduced ability to disperse in the water column compared to higher viscosity oils, approximately 13% of the diesel released would reach the seabed. This is supported by an assessment of a release of 916.8m^3 of diesel from a vessel in the South Morecambe Field [41]. Areas of sediment contamination would be likely to include some protected areas. Modelling suggests that the concentration of diesel in offshore sediments would be <0.01g/m^2 across much of the affected area. Higher concentrations were predicted in coastal areas, for example 0.5g/m^2 off the coast of Walney Island; 1.05 g/m^2 in the coastal area near Blackpool; and 5.3g/m^2, the highest concentration from the modelled scenarios, in the River Kent estuary in Morecambe Bay. However, the predicted contamination levels are lower than the sediment background concentration of 6.875g/m^2 [41]. The potential significance of impacts on seabed sediment quality from a large hydrocarbon release has therefore been assessed as **low**.

Diesel would be expected to beach on affected shorelines from five days after the release (Figure

7.2.2). Shoreline hydrocarbon contamination is categorised as 'light', 'moderate' and 'heavy oiling' by the International Tanker Owners Pollution Federation (ITOPF) based on the quantity of stranded hydrocarbon across the intertidal area [44]. These contamination categories are summarised in Table 7.2.1. Stochastic modelling of a 9,171m^3 release of marine diesel at DP3 predicts the largest mass of beached oil would occur in the summer [107]. The model output predicts maximum concentrations of up to 11kg/m^2, potentially categorised as heavy oiling on the ITOPF scale, on stretches of the northwest coast of England (including the Duddon Estuary, parts of Morecambe Bay, and the Ribble Estuary), on the southeast coast of the Isle of Man and the south coast of Dumfries and Galloway, Scotland [107]. The highest concentrations are predicted in estuaries and sheltered coastal areas.

CONTAMINATION SCALE	Litres/m^2	Kg/m^2
Light	<0.1	<0.0843
Moderate	0.1 - 1	0.0843 – 0.843
Heavy	>1	>0.843

Table 7.2.1: ITOPF shoreline contamination categories

However, the maximum shoreline hydrocarbon concentration predicted by the modelling conservatively assumes the shoreline width to be only 2m. The shoreline intertidal area around the EIS, particularly in Morecambe Bay and estuary areas, is much wider than this and therefore the hydrocarbon concentrations predicted are significantly higher than would be expected to occur in the event of an actual release. For example, in the area with the highest modelled shoreline concentration (10.98kg/m^2 near Annaside on the Cumbrian coast), the width of the intertidal area is at least 270m. The average concentration of shoreline hydrocarbon in the area would therefore be approximately 0.081kg/m^2, categorised as light oiling. In estuaries, the intertidal area is much wider, and shoreline contamination would be categorised as light in most areas.

As illustrated in Figure 7.2.2, the maximum mass of diesel beached in the worst case is 1,270Te, predicted to occur after 13.5 days (15.9% of total). After 30 days, the mass of beached oil would reduce to 418Te (5.2%) as a result of reworking of hydrocarbon in to the sediment by tides and waves, and continued evaporation and biodegradation [107]. The area of shoreline impacted would be relatively small part of the EIS coast, the trajectory of the diesel determined by the direction of winds and currents after the release.

Therefore, the significance of impacts on the shoreline from a large hydrocarbon release has been assessed as **medium**. Given the low probability of such a release, the overall risk of associated impacts on sediment quality has been assessed as **low**.

7.2.2.3 Plankton

The planktonic community is composed of a range of microscopic plants (phytoplankton) and animals (zooplankton) that drift with the oceanic currents. As hydrocarbon can float on the water's surface and disperse within the ocean as it weathers, plankton are exposed to both floating hydrocarbon slicks and to small dissolved droplets of hydrocarbon in the water column ([2], [16]).

Changes in the patterns of distribution and abundance of phytoplankton can have a significant impact on the entire ecosystem [76]. Both hydrocarbon and hydrocarbon biodegradation can cause problems for phytoplankton in the immediate vicinity of a spill. Hydrocarbon slicks can inhibit air-sea gas exchange and reduce sunlight penetration into the water, both essential to photosynthesis and phytoplankton growth [32]. The polycyclic aromatic hydrocarbons (PAHs) in the oil also affect phytoplankton growth, with responses ranging from stimulation at low concentrations of oil (1mg/l i.e. 1,000ppb) to inhibition at higher concentrations (100mg/l i.e. 100,000ppb) [35].

Zooplankton at the air-sea interface are thought to be particularly sensitive to hydrocarbon spills, due to their proximity to high concentrations of dissolved hydrocarbon, and to the additional toxicity of photo-degraded hydrocarbon products at this boundary [9]. Zooplankton may suffer from loss of food resource. Therefore, hydrocarbon toxicity may result in death, as well as impaired feeding, growth, development, and reproduction [10]. The limited swimming ability of the free-floating early life stages (meroplankton, i.e. eggs and larvae) of invertebrates such as echinoderms, molluscs and crustaceans renders them unable to escape hydrocarbon-polluted waters. These early life stages are more sensitive to pollutants than adults and their survival is critical to the long-term health of the adult populations [10].

However, impacts on plankton populations from hydrocarbon releases are typically short term and localised. Zooplankton biomass was documented in the month following the Tsesis oil spill off the coast of Sweden in 1977 (1,000Te of medium grade fuel oil) with biomass levels being re-established within five days [48]. Plankton populations are abundant and widespread, with high rates of reproduction. Typically, recruitment from adjacent areas not affected by the release is sufficient to replace losses [47].

Therefore, the significance of impacts on plankton from a large hydrocarbon release has been assessed as **low**. Given the low likelihood of such a release, the overall risk of associated impacts on plankton has been assessed as **low**.

7.2.2.4 Benthos

In response to hydrocarbon exposure, benthic fauna can either move, tolerate the pollutant (with associated impacts on the overall health and fitness), or die ([33], [59]). The response to hydrocarbon by benthic species differs depending on their life history and feeding behaviour, as well as the ability to metabolise toxins, especially PAH compounds. However, severe oil pollution typically causes initial massive mortality and lowered community diversity, followed by extreme fluctuations in populations of opportunistic mobile and sessile fauna [98], such as the opportunistic polychaete *Capitella capitate*.

There is little documented evidence on the impact of a marine diesel spill of the scale which could potentially occur at DP3 or DP4. Theoretically, the sandy mud benthic communities in the area (Section 6.2.2) are highly likely to be adversely affected should they be exposed to a diesel pollution event, depending on the exposure time [101]. Any diesel contamination would remain in the sandy mud sediment for a long time after the pollution event, and ingestion would be likely by the deposit feeders that characterise this biotope [18]. The brittlestar *Amphiura filiformis* is very intolerant of the toxic effects of oil pollution [74], as are infaunal polychaetes, bivalves and amphipods occupying marine soft sediment habitats [98].

Although sensitive to hydrocarbon pollution, marine diesel would be concentrated at the surface following a spill event, and therefore benthos is likely to be protected by its depth [18]. OSPAR has adopted 50mg/kg as the hydrocarbon concentration threshold above which toxic effects on benthic fauna may begin to be discernible (in the context of Oil Based Mud contamination). This equates to 5g/m^2 assuming that the oil will distribute through a 5cm sediment layer and assuming a sediment density of 2.0Te/m^3. As discussed in Section 7.2.2.2, given the low persistence of diesel in the marine environment and the large proportion of diesel expected to evaporate, sediment hydrocarbon concentrations are unlikely to exceed 5g/m^2 in subtidal areas.

Shoreline hydrocarbon concentrations above 100g/m^2 would be enough to coat benthic epifaunal invertebrates living on hard substrates in intertidal habitats, thus compromising the animals [24]. This is also close to the lower concentration above which ‘light’ oiling is defined by ITOPF (84g/m^2). Potential impacts on benthos in intertidal sediments are addressed in Section 7.2.2.8.

The significance of impacts on seabed benthos from a large hydrocarbon release has been assessed as **low**. Given the low likelihood of such a release, the overall risk of associated impacts on benthos has been assessed as **low**.

7.2.2.5 Fish and shellfish

Exposure of fish to hydrocarbons can occur either through uptake across the gills or skin or direct ingestion of oil or oiled prey. Pelagic species, which spend the majority of their life-cycle in the water column, are likely to receive the highest exposure to oil that remains near the surface, whereas demersal fish species, associated with the seabed, are more exposed to particle-bound contaminants.

The chemical components of light oils, including diesel, have a high biological availability and toxic impacts are more likely than from a heavy crude. At exposure levels lower than those sufficient to cause mortality, contamination may lead to sub-lethal effects such as impaired feeding and reproduction [47]. Diesel has the potential to impact spawning success because eggs and larvae of many fish species are more sensitive to oil toxins.

Despite the sensitivity of the juvenile fish life stages to hydrocarbons, adult fish are more resilient. Significant effects on wild stocks have seldom been detected and fish are thought to actively avoid hydrocarbons [47]. Once the hydrocarbon disappears from the water column fish generally lose contamination from their tissues quickly due to their ability to metabolise accumulated hydrocarbons very rapidly [56]. Localised mortality of eggs and larvae which may occur following a spill, rarely impacts wider populations. Marine organisms are adapted to acute local impacts by the production of vast surpluses of eggs and larvae, and recruitment from outside the affected area [45]. Species thought to be present on the EIS, as described in Section 6.2.3, form part of larger populations, such that significant impacts on individuals would not have a significant impact at a population level. Furthermore, the concentration on diesel near the surface would limit exposure, particularly of adults of demersal species like cod, whiting, plaice, and sole.

The significance of impacts on fish from a large hydrocarbon release has been assessed as **low**. Given the low likelihood of such a release, the overall risk of associated impacts on fish has been assessed as **low**.

7.2.2.6 Marine mammals

Marine mammals may be exposed to hydrocarbons either internally (swallowing contaminated water, consuming prey containing oil-based chemicals, or inhaling of volatile oil related compounds) or externally (swimming in oil or oil on skin and body).

The effects of hydrocarbons on marine mammals are dependent upon species but may include:

- Hypothermia due to conductance changes in skin or fur;
- Toxic effects and secondary organ dysfunction due to ingestion of oil, congested lungs;
- Damaged airways;
- Interstitial emphysema due to inhalation of oil droplets and vapour;
- Gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding;
- Eye and skin lesions from continuous exposure to oil;
- Decreased body mass due to restricted diet; and,
- Stress due to oil exposure and behavioural changes.

Marine mammals recorded regularly in the EIS are the harbour porpoise, bottlenose dolphin, white beaked dolphin, and grey seal, all at relatively low densities (see Section 6.2.4).

There is little documented evidence of cetaceans being affected by hydrocarbon spills. Evidence suggests they do not necessarily avoid slicks. Observations of bottlenose dolphins suggest that they did not detect a hydrocarbon sheen and that although they detected a slick, they did not avoid travelling through it [91]. Similarly, gray whales *Eschrichtius robustus* have been observed to swim through oil seeps off California [23]. Lack of an olfactory system likely contributes to the difficulty cetaceans have in detecting oil. Waves and darkness can reduce their visual ability at the surface and it is possible that individuals could resurface within a fresh slick and find it difficult to locate hydrocarbon-free water [65].

Cetaceans have smooth skins with limited areas of pelage (hair covered skin) or rough surfaces. Hydrocarbon tends to adhere to rough surfaces, hair or calluses of animals, so contact may cause only minor adherence. However, cetaceans can be susceptible to inhaling hydrocarbon and hydrocarbon vapour when they surface to breathe. This may lead to damaging of the airways, lung ailments, mucous membrane damage or even death.

Seals are vulnerable to oil pollution because they spend much of their time near the surface and regularly haul out on beaches. Seals have been seen swimming in hydrocarbon slicks during several documented spills [31]. Most seals scratch themselves vigorously with their flippers but do not lick or groom themselves so are less likely to ingest hydrocarbon from skin surfaces. However, a seal mother trying to clean an oiled pup may ingest hydrocarbon, and it is pups that are most vulnerable to hydrocarbon spills when it reaches breeding colonies on the shoreline. Furthermore, seals use smell to identify their young in a large colony. If the mother cannot identify its pup because it's scent has been masked by diesel, this can result in abandonment and starvation.

However, marine mammals would not be expected to be killed by a hydrocarbon spill unless subjected to very high levels of contamination, and most individuals will recover quickly and suffer only short term effects [76].

Therefore, the significance of impacts on marine mammals from a large hydrocarbon release has been assessed as **low**. Given the low likelihood of such release, the overall risk of associated impacts on marine mammals has been assessed as **low**.

7.2.2.7 Seabirds

Seabirds are particularly sensitive to the effects of surface oil pollution, and some oil pollution incidents have resulted in mass mortality of seabirds (e.g. [70] and [102]). Mortality occurs from the ingestion of oil, which results in liver and other organ failure, as well as contamination of plumage, which destroys the insulating properties, leading to hypothermia [3].

Seabird sensitivity to oil pollution is classed as very high around both DP3 and DP4 from October to March. Sensitivity reduces through the spring as seabirds migrate to coastal breeding areas, and is lowest between June and October when sensitivity is considered medium to low, except in August when sensitivity is considered to be high around DP4 (see Section 6.2.5).

However, the effect of oil pollution on seabirds is not uniform and depends on the numbers of seabirds at sea around the pollution incident. It also has an unequal effect on different seabird species, with diving seabirds such as seaducks (*Anatidae*), divers (*Gaviidae*), cormorants (*Phalacracoracidae*), grebes (*Podicepididae*) and auks (*Alcidae*) more susceptible than more aerial species such as gulls (*Laridae*) [104].

Susceptible species tend to spend a greater proportion of their time on the sea and have limited ability to locate alternate feeding sites. At the population level, species with small or geographically limited populations, a low potential reproductive rate (productivity), and low adult survival rates are additionally sensitive due to their limited ability to recover [104].

The sea area around DP3 and DP4 with a high probability (>40%) of surface oiling is approximately 97km^2, although the actual area with surface diesel would be a small fraction of this area. Evidence suggests seabird densities in the vicinity of DP3 and DP4 are relatively low [55]. This applies to the little gull (*Hydrocoloeus minutus*), which uses offshore areas of Liverpool Bay from October to March and is protected by the Liverpool Bay SPA. DP3 and DP4 are located to the west and northwest of the area with the highest little gull winter densities (Figure 6.2.7), but the area with a high probability (>40%) of surface oiling does overlap the high density little gull area. Therefore, a large diesel release between October and March could impact the little gull population, although the potential impact is mitigated by the relatively low sensitivity of little gull to oil pollution. Using an index of zero to one (where zero is not sensitive and one is maximum possible sensitivity), little gull has an index score of 0.305 in winter (0.278 in summer) [104].

Seabirds are more abundant in coastal waters to the north in summer (April to October) and to the east in winter (November to March) [55], and this is reflected in seabird sensitivity in these areas (Section 6.2.5). The coastal waters of the Liverpool Bay area contain wintering red-throated diver (*Gavia stellata*) and common scoter (*Melanitta nigra*) between October and February, and between September and April respectively. The highest concentrations of these species occur between Formby Point to Shell Flat (off Blackpool), off the Ribble Estuary, North Wales, and the North Wirral foreshore [71].

Red throated divers are vulnerable to hydrocarbon pollution, particularly during September and October when they moult their flight feathers. The overall sensitivity of the red throated diver to surface hydrocarbon pollution is 0.808 throughout the year. Common scoter is also sensitive (0.667 in summer; 0.712 in winter) [104].

In the event of a spill the diesel would evaporate from the surface over a matter of days (Figure 7.2.2), and would be present in patches. Nevertheless, the area potentially impacted by a spill (albeit with low probability) coincides with areas of extremely high seabird sensitivity, and a relatively low exposure time is needed to compromise a bird.

Therefore, the significance of impacts on seabirds from a large hydrocarbon release has been assessed as **high**. However, given the low likelihood of such a release, and the relatively low probability of hydrocarbon reaching sensitive areas, the overall risk of associated impacts on seabirds has been assessed as **medium** and 'as low as reasonably practicable'.

7.2.2.8 Protected areas

The likelihood of hydrocarbon interacting with protected areas is illustrated in Figure 7.2.3.

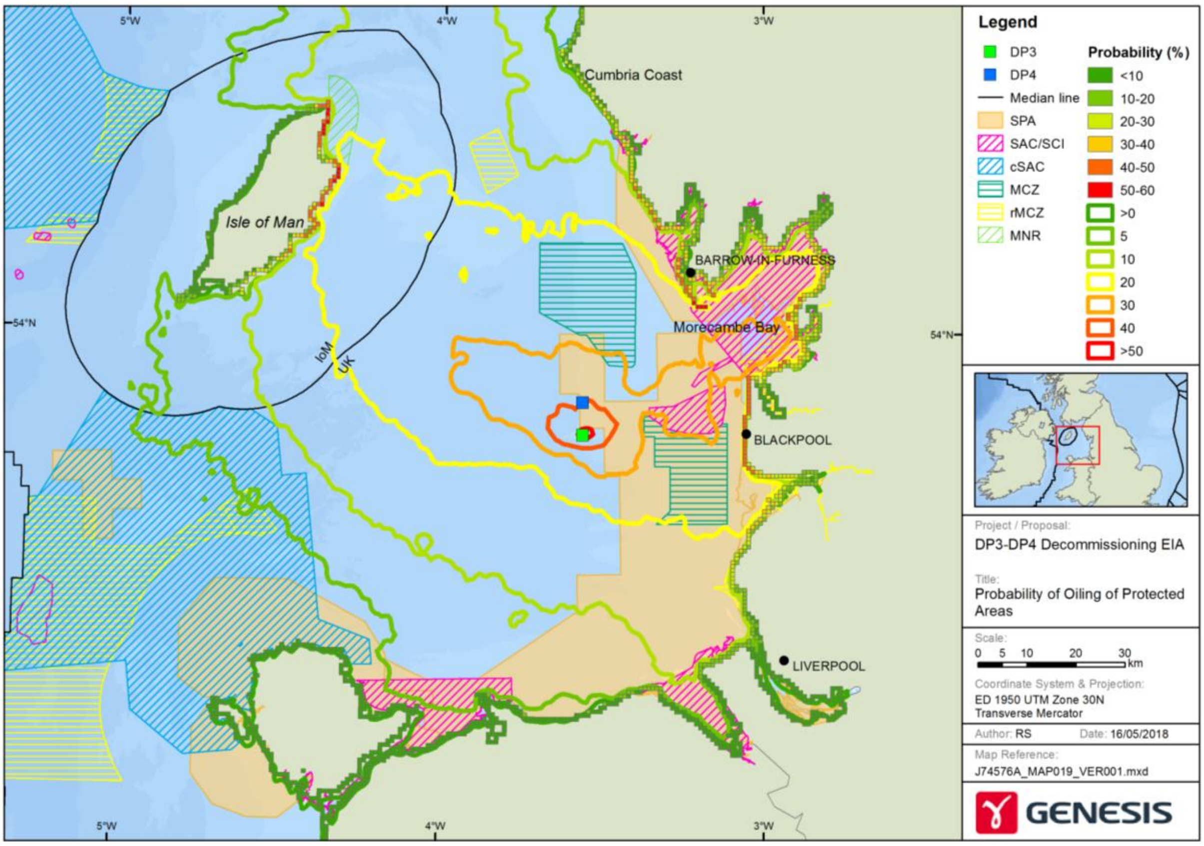

Figure 7.2.3: Probability of surface and shoreline oiling and interaction with protected areas

This highlights the probability of surface oiling within the Liverpool Bay/Bae Lerpwl SPA, and the probability of oil beaching within the Liverpool Bay/Bae Lerpwl SPA, the Morecambe Bay SAC, the Morecambe Bay and Duddon Estuary SPA, and the Ramsay MPA. Nearby, fully offshore designated areas have <40% probability of surface oiling. These include the West of Walney and Fylde MCZs, designated for sensitive sea-pen and burrowing megafauna communities and subtidal sand and mud habitats, and Shell Flat and Lune Deep SAC, designated for reef habitats and sandbanks which are slightly covered by seawater all the time. Diesel will be concentrated at the surface, and therefore these benthic communities are likely to be protected by their depth (Section 7.2.2.4). However, protected habitats and species in shallow and intertidal areas could be impacted by hydrocarbons in areas where shoreline oiling is possible, and the sensitivity of these has been assessed.

Intertidal mudflats and sandflats

Intertidal mudflats and sandflats provide a habitat for burrowing, detritus-feeding invertebrates. They are very productive, providing a food source for fish and bird populations. Many burrowing invertebrates are highly sensitive to toxic hydrocarbon components. Recovery is determined by the degree of penetration and persistence of hydrocarbon in the sediment but is typically 2-4 years [76]. Contamination levels would be light in most impacted areas. However, taking a conservative approach it is assumed that hydrocarbon concentrations could be sufficient to impact invertebrate communities, and therefore the significance of impacts on intertidal mudflats and sandflats has been assessed as **high**.

Coastal wading birds

Important populations of waders feed on intertidal mudflats and sandflats around the EIS coastline. In the event of hydrocarbon reaching these shorelines, individual birds may be indirectly affected by eating oil-contaminated food organisms, although this is not considered to be a major cause of bird deaths [76]. A reduction in invertebrate abundance and productivity could reduce food availability in impacted areas. Hydrocarbon concentrations would be low in most areas, but assuming an impact on food availability the significance of impacts on waders and waterbirds has been assessed as **high**.

Saltmarsh

Saltmarsh habitats are considered highly sensitive to oil spills, with lighter oils being the most toxic. Some plant species, particularly annuals, can be killed by a single spill whereas others are more resilient. Recovery depends on retention of oil, with annuals recolonising in < 3 years [99]. Contamination levels would be light in most impacted areas. However, taking a conservative approach it is assumed that a significant area of saltmarsh habitat could be impacted, and therefore the significance of impacts on saltmarsh has been assessed as **medium**.

Coastal lagoons

Lagoons can act as sinks for contaminants, which may accumulate and reach levels that are toxic to lagoon communities [22]. Hydrocarbons would persist longer in lagoons than more exposed areas. General information about the sensitivity of lagoons is lacking because they can contain several different habitats. They often contain eelgrass meadows which have relatively low sensitivity to hydrocarbons [18], but the general sensitivity of lagoons to hydrocarbon contamination is probably is greater, and therefore the significance of impacts on coastal lagoons has been assessed as **medium**.

A high-level assessment of the potential significance of hydrocarbon contamination on protected areas with a relatively high probability of oiling (>40%) is summarised in Table 7.2.2.

PROTECTED AREA	DISTANCE (KM)	PROBABILITY OF OILING (%)* SURFACE	SHORE	SIGNIFICANCE OF POTENTIAL IMPACT**	
Liverpool Bay/Bae Lerpwl (SPA)	0	100	50	H	An internationally important waterbird assemblage could be impacted, including important non-breeding little gull areas in the vicinity of DP3 and DP4 (Section 7.2.2.7). Accounting for shoreline width, there is potential for light shoreline oiling within the SPA.
Ramsay Marine Nature Reserve (MNR)	68.0	26	61	M	Protected horse mussel reefs, maerl beds and eelgrass meadows could be impacted as well as sustainable fisheries within the MNR. Healthy populations of eelgrass exist in the presence of long term, low level hydrocarbons [18], and maerl beds are not considered sensitive to low levels of hydrocarbon contamination [80]. As mussels are filter feeders, hydrocarbons may be ingested or absorbed, especially PAHs, reducing feeding rates and fitness. These subtidal habitats would be partially protected from contact with hydrocarbon by their depth.
Morecambe Bay (SAC)	28.7	34	54	H	Intertidal mudflats and sandflats, important saltmarsh areas, coastal lagoon areas and sandbanks which are slightly covered by water at all times could be impacted. Accounting for shoreline width, shoreline oiling within the SAC would be light, therefore reducing the potential scale of impacts.
Morecambe Bay and Duddon Estuary (SPA)	24.8	33	54	H	Overwintering waterbirds and waders, migrating waders in spring and autumn, and summer breeding terns could be impacted. Accounting for shoreline width, there is potential for light shoreline oiling within the SPA.
Wyre-Lune (pMCZ)	33.3	33	49	M	Estuaries containing important saltmarsh areas and fish nursery areas, including smelt. Accounting for shoreline width, light shoreline oiling is possible across most of the pMCZ, although accumulations in parts of the Lune Estuary could reach moderate levels. Smelt spawn upriver in freshwater during February and March, so no impact on eggs is anticipated. Impacts on larvae are possible, but adult populations should be resilient (Section 7.2.2.5).
Ribble and Alt Estuary (SPA)	24.7	26	45	H	A wintering waterbird assemblage and seabird breeding assemblage of international importance. The higher risk of oiling is in Autumn. Accounting for shoreline width, light shoreline oiling is possible across most of the SPA, although accumulations in parts of the Ribble Estuary could reach moderate levels.
*March to November inclusive **Scale: High (H), Medium (M), Low (L)					

Table 7.2.2: Potential impacts on protected areas with a >40% probability of oiling

The worst case significance of impacts on protected areas from a large hydrocarbon release has been assessed as **high**. Given the low likelihood of a large hydrocarbon release, the overall risk of associated impacts on protected areas has been assessed as **medium** and 'as low as reasonably practicable'.

7.2.2.9 Fisheries

As discussed in Section 7.2.2.5, localised mortality of eggs and larvae which may occur following a spill, rarely impacts wider fish stocks, and adult fish are relatively resilient to hydrocarbon spills.

More significant impacts may be found near shore, where hydrocarbons can accumulate and exposure, particularly of intertidal and shallow subtidal benthos like bivalve molluscs and crustacea, can be greater [45][44]. Shellfish are harvested and cultivated in Morecambe Bay and along the North Wales coast [8]. It is possible that a large hydrocarbon release could impact designated shellfish waters in Morecambe Bay and the Ribble Estuary, illustrated in Figure 6.4.1.

At mariculture sites, mortality has occurred only in the most serious cases of hydrocarbon contamination, and impacts are generally sublethal, sometimes resulting in tainting or the product with a hydrocarbon [76]. The Transocean Winner semi-submersible rig ran aground near the Isle of Lewis, Scotland on 8th August 2016 resulting in the release of up to 53m^3 of diesel near the coast. Investigation of the environmental impact is ongoing but initial sampling in the days following the incident showed no discernible increase in petrogenic contamination in mussels with respect to typical farmed concentrations from a clean site [63]. However, it is acknowledged that there is the potential for tainting of shellfish species.

The potential significance of impacts on fisheries from a large hydrocarbon release has been assessed as **medium**. Given the low likelihood of such a release, the overall risk of associated impacts on fisheries has been assessed as **low** and 'as low as reasonably practicable'.

7.2.2.10 Local communities

The smell and appearance of stranded oil may be a nuisance to people living on the affected shoreline. Coastal tourism is an important industry in some areas, particularly in the warmer months. In the EIS, areas with the highest modelled probability of shoreline contamination include the shoreline around Blackpool, Morecambe, and the east coast of the Isle of Man. These include several blue flag beaches.

Beaches may have to be temporarily closed and recreational pursuits restricted following contamination. However, these impacts are usually comparatively short-lived. Once shorelines are clean normal trade and activity would be expected to resume, although media attention may cause disproportionate damage to the image of the local tourist industry, aggravating economic losses by contributing to public perception of prolonged widespread pollution [46].

The significance of impacts on local communities from a large hydrocarbon release has been assessed as **medium**. Given the low likelihood of such a release, the overall risk of associated impacts on local communities has been assessed as **low** and 'as low as reasonably practicable'.

7.2.3 Cumulative and transboundary impacts

The DP3 and DP4 platforms are located approximately 115km east of the UK/Ireland jurisdictional median line. The territorial waters of Isle of Man (IoM) are located 42km to the northwest (of DP4). The modelled spill scenario shows that the highest probability of transboundary impacts from a diesel spill would be in the spring period (March to May). The maximum probability of surface oiling in IoM territorial waters would be 29.7% over the period March to November, or 52.7% over the spring period alone. There would be a low probability (0.9-9.1%) of surface oiling occurring in Irish waters following a spring release, and outside of spring, surface oiling of Irish waters would be very unlikely (Figure 7.2.1). Spill modelling indicates that shoreline oiling is possible on the IoM and Ireland, particularly in the between March and May, with a maximum 76.4% probability for shoreline oiling on the east coast of the IoM in spring. Over the full modelled period, the maximum probability for shoreline oiling on the IoM is 60.6% [107].

The significance of transboundary impacts from a large hydrocarbon release has been assessed as **medium**. Given the low likelihood of such a release, the overall risk of transboundary impacts has been assessed as **low** and 'as low as reasonably practicable'.

7.2.4 Control and mitigation measures

- Releases, including potential large hydrocarbon releases, will be managed under the existing Morecambe Hub OPEP [40]. The OPEP will be updated with details of any additional hydrocarbon inventory brought in to the field by the decommissioning activities;
- All vessel activities will be planned, managed and implemented in such a way that vessel durations in the field are minimised; and
- Spirit Energy's existing marine procedures will be adhered to minimise risk of hydrocarbon releases.

These control measures are considered to be effective in reducing and minimising the risk of a loss of vessel fuel inventory during the decommissioning activities to 'as low as reasonably practicable'.

7.2.5 Conclusions

The sole source of a potential unplanned large volume release of diesel to sea is associated with loss of containment from a vessel. The worst case in terms of volume and rate of release would be the immediate total loss of diesel inventory to sea as a consequence of collision or mechanical failure. This eventuality is considered highly unlikely owing to the procedural (vessels' management systems) and operational controls that will be applied.

Diesel has very high levels of light hydrocarbons and therefore evaporates quickly on release. The low asphaltene content prevents emulsification reducing its persistence in the environment. The modelling has shown that the area of high surface oiling probability (>40%) is relatively small. It would potentially interact with seabirds, which are sensitive to surface oil and likely to be present at low densities. A release between October and March could result in surface oiling in an area, used by little gull, which is a protected feature of the Liverpool Bay/Bae Lerpwl SPA. The probability of shoreline oiling is highest (>40%) along the east coast of the IoM and on parts of Lancashire and Cumbrian coasts. Levels of contamination would be low on most impacted shorelines. However, there is potential for impacts on the protected features of several coastal protected areas, including intertidal mudflats and sandflats, saltmarsh areas, coastal lagoon areas, and associated coastal bird populations.

The risk of a vessel release will be managed through Spirit Energy's existing marine procedures. In the unlikely event of a release, the response will be managed under the Morecambe Hub OPEP [40] and project vessel Shipboard Oil Pollution Emergency Plans (SOPEPs). The OPEP will be updated with additional inventory and additional mitigation measures identified and implemented should modelling show increased risk.

In summary, the worst case significance of impact from a large unplanned release of diesel to sea as a result of decommissioning DP3 and DP4 is considered to be **high**. The significance of the risk of this impact, given the low likelihood of such a release, and with the identified control and mitigation measures in place, is considered **medium** and 'as low as reasonably practicable'.

8. CONCLUSIONS

It is expected that the DP3 and DP4 platforms will be decommissioned by Spirit Energy in the period 2020 to 2021. This EA has assessed the removal of the DP3 and DP4 platforms and their recovery to shore. Spirit Energy plans to remove and recover to shore for preferential recycling the platform topsides and jackets, with the exception of the portion of the jacket foundation piles located in excess of 1m below natural seabed, which will be decommissioned *in situ*. Pipelines and cables approaching DP3, DP4, CPP1 and DP8 and will be cut at a point at which they are sufficiently buried, and sections not sufficiently covered by sediment will be removed and recovered to shore for preferential recycling along with their associated protection and stabilisation features (including mattresses and grout bags).

The impacts and potential impacts (risks) associated with physical presence, resource use, energy use and atmospheric emissions, underwater sound, seabed disturbance, discharges and releases, large hydrocarbon releases, and waste production, have been evaluated (on a scale of 'low', 'medium' and 'high' significance) given the application of industry standard control and mitigation measures. A summary of the environmental sensitivities of the receiving environment local to DP3 and DP4 is presented in Section 6. The significance of the impacts of all planned activities was considered to be **low**, with the exception of those that will result in seabed disturbance, the impacts of which are evaluated as **medium**.

The EA assessed the significance, again following control and mitigation, of the risk associated with an unplanned (accidental) large hydrocarbon release, as **medium**.

Physical presence

The physical presence of project vessels may result in temporary navigational hazards and nuisance to shipping, and a temporary restriction of fishing operations outside the DP3 and DP4 500m safety zones. Interactions with other vessels will be managed through existing marine procedures and, where applicable, the consent to locate process. Short term increases in vessel traffic are unlikely to disturb or injure marine mammals or birds. The increase in vessel traffic is not anticipated to result in a significant change to existing levels.

The removal of DP3 and DP4 will remove obstructions to shipping and return two areas of seabed for exploitation by fishing. Once recovered to shore, materials will be managed under, and in compliance with, appropriate environmental permits and licences and in compliance with relevant waste legislation.

The significance of the impacts from physical presence associated with the removal of infrastructure, use of vessels, and management of materials is considered to be **low**.

Resource use

Decommissioning of DP3 and DP4 will use steel to reinforce the topsides ready for lifting. However, this steel will be recovered to shore and recycled. The steel in the bottom portion of the jacket foundation piles, which will be decommissioned *in situ*, will be permanently lost. It is not technically feasible to recover the piles more than below 1m below natural seabed, which constitutes approximately 11% of the steel in DP3 and DP4. The remaining 89% will be recovered and made available as a resource by recycling.

Most the materials in the DP3 and DP4 pipelines and cables will be left buried *in situ* and will therefore be lost. This equates to approximately 96% of the steel resource in the decommissioned pipelines and cables.

In the context of UK steel resources, the steel lost it the foundation piles and buried pipelines and cables will not be significant. The significance of impacts associated with resource use is considered to be **low**.

Energy use and atmospheric emissions

The decommissioning activities' direct and indirect energy requirements will result in the emission of a range of gaseous combustion products, primarily carbon dioxide (CO_2) but including nitrogen oxides (NO_x), nitrogen dioxide (N_2O), sulphur dioxide (SO_2), carbon monoxide (CO), methane (CH_4) and volatile organic compounds (VOCs). Vessel activities will have a direct energy requirement, whereas onshore processing of materials, particularly steel, will have an indirect energy requirement.

Vessel fuel consumption will be minimised under the existing marine procedures and the vessels' work programme. Emissions will be localised and of relatively short duration. They are expected to disperse rapidly and dilute to background concentrations. Steel processing and associated energy use and emissions will be managed under, and in compliance with, appropriate site environmental permits and licences, and will recycle approximately 20,953Te of steel resource. The significance of the impacts associated with energy use and its atmospheric emissions is considered **low**.

Underwater sound

Vessel activities are expected to be the most significant project source of underwater sound, with use of excavation and cutting tools, lifting and the use of acoustic surveying equipment producing lower sound levels. Marine mammals and some fish species are potentially sensitive to underwater sound, but project sources of underwater sound are not deemed capable of causing any physical injury to acoustically sensitive species. Local behavioural responses may be triggered by short duration, intermittent activities. However, fish and marine mammal behaviour would be expected to be habituated to general vessel sound in an area of moderate to high background vessel activity.

Vessel activities will be managed under existing marine procedures and the significance of impacts from underwater sound is considered **low**.

Seabed disturbance

The principal sources of seabed disturbance are the positioning of HLV anchors, and the potential overtrawl assessment. These activities will result in deposits on, and physical abrasion of the seabed, causing direct mortality or physical injury to benthos. Indirect disturbance of sediment will result in increased turbidity and/or smothering of benthos.

Available evidence, subject to a pre-decommissioning environmental survey, suggests that the local seabed community is likely to be tolerant of increased turbidity and/or smothering. However, a proportion of the benthic population is likely to be damaged or killed by anchor deployment and any overtrawl assessment. Depending on the population losses in impacted areas, and on the rate of immigration or larval recruitment, recovery would be expected in less than 3 years. The impacted species and habitat are relatively widespread throughout the EIS and the area anticipated to be impacted represents a very small percentage of the available habitat.

Standard measures to control disturbance include operational planning and equipment selection. The number of deployments of HLV anchors and the area of any overtrawl survey will also be minimised. In summary, due to the localised and relatively short duration of the decommissioning activities, and with the identified control and mitigation measures in place, the overall significance of the impact of seabed disturbance is considered **medium** and 'as low as reasonably practicable'.

Discharges and releases to sea

Planned discharges to sea associated with decommissioning activities are related to operational vessel discharges and the discharge of any small, residual quantities of chemicals and hydrocarbons when pipelines are disconnected. There is also potential for unplanned (accidental) releases of hydrocarbons or chemicals from vessels or the DP3 and DP4 topsides. These have the potential to negatively impact water and sediment quality, plankton, benthos, fish, and birds.

Project inventories of chemicals and hydrocarbons will be relatively small following preparatory cleaning of pipelines and the topsides process systems, except for vessel diesel fuel tanks (discussed under large hydrocarbon releases). Any planned discharges will be small, localised, of short duration or intermittent nature. Planned discharges will be risk assessed and permitted in compliance with relevant legislation and will disperse and dilute rapidly in the marine environment. Unplanned releases to sea will be managed under the Morecambe Hub OPEP and project vessel SOPEPs.

Onshore, any discharges and releases associated with processing of recovered materials will be managed by appropriately licenced waste management sites and carriers.

The significance of impacts from discharges and releases is considered **low**.

Large hydrocarbon releases

Project vessel fuel inventories introduce the risk of an unplanned large volume release of hydrocarbons to sea. The largest inventory is likely to be on the HLV and based on a review of the HLVs capable of lifting and removing the DP3 and DP4 topsides and jackets, a diesel inventory of 9,171m^3 has been identified. A release of this volume to sea at DP3 was modelled to understand the potential fate of the hydrocarbon, and its impact on environmental receptors.

Compared to many other hydrocarbons, diesel does not persist for long in the environment. However, the modelling has shown that surface hydrocarbons would potentially interact with seabirds, which are sensitive to surface hydrocarbons and are likely to be present near DP3 and DP4 at low densities and at higher densities closer to shore at certain times of the year. Shoreline oiling is possible from a large diesel release and would be most likely along the east coast of the IoM or on parts of the Lancashire and Cumbria coasts. Levels of contamination would be light on most impacted shorelines. However, there is potential for impacts on the protected features of several coastal protected areas, including intertidal mudflats and sandflats, saltmarsh areas, coastal lagoon areas, and associated coastal bird populations.

The risk of a vessel release will be managed through Spirit Energy's existing marine procedures. In the unlikely event of a release, the response will be managed under the Morecambe Hub Oil Pollution Emergency Plan (OPEP) and project vessel Shipboard Oil Pollution Emergency Plans (SOPEPs). The significance of the risk of impacts from a large hydrocarbon release, given its very unlikely probability of occurrence, is considered low for all receptors except seabirds and protected areas, for which the risk is considered **medium** and 'as low as reasonably practicable'.

Waste

Materials recovered by decommissioning activities will be transported to a shore base for light processing and then transferred to appropriate waste management facilities, according to the principles of the waste hierarchy. The project aspiration is to recycle >95% of recovered materials, and disposal to landfill will only be used as a last resort. All waste management sites and waste carriers will hold appropriate environmental and other operating licences, and compliance with the relevant waste legislation will be closely managed within contractor assurance processes.

The significance of impacts associated with waste production is considered **low**.

Cumulative and transboundary impacts

The significance of the cumulative impacts of increased vessel activity (physical presence), steel resource use, energy use and atmospheric emissions, underwater sound, seabed disturbance, discharges and releases, large hydrocarbon releases and waste production is considered **low**.

Given the distance of DP3 and DP4 from the UK/Ireland jurisdictional median line and IoM territorial waters, and the localised extent and short duration of the majority of identified impacts, few significant transboundary impacts are anticipated. In the event that the shore base for receiving recovered materials is not in the UK, only permitted facilities would be used for materials recycling or disposal. Transboundary impacts associated with materials processing, waste management and disposal to landfill have been assessed as **low**. The only other potential transboundary impact would be from a large hydrocarbon release.

Modelling of the worst case potential hydrocarbon release indicates that the probability of transboundary impacts is highest in the spring period (March to May) when there is a low probability (0.9-9.1%) of surface oiling occurring in Irish waters. The maximum probability of surface oiling in IoM territorial waters in spring would be significantly higher at 52.7% but would be 29.7% over the full modelled period. Outside of spring surface of oiling of Irish waters is very unlikely (Figure 7.2.1). Spill modelling indicates that shoreline oiling is possible on the Isle of Man and Ireland, particularly in the between March and May, with a maximum 76.4% probability of shoreline oiling on the east coast of the Isle of Man in spring, or 60.6% over the full modelled period [107].

The potential significance of transboundary impacts on from a large hydrocarbon release has been assessed as **medium**. However, given the low likelihood of a large hydrocarbon release, the overall risk of transboundary impacts is considered **low**.

8.1 Environmental management

Spirit Energy will follow industry standard environmental management activities, including management of contractors, vessel audits, and compliance with legal requirements and environmental permit and consent conditions, such that the environmental impact of DP3 and DP4 decommissioning will be minimised. A summary of proposed control and mitigation measures is shown in Table 8.1.1.

CONTROL AND MITIGATION MEASURES
General and Existing
• Lessons learnt from previous decommissioning scopes will be reviewed and implemented as appropriate; • Vessels will be managed in accordance with existing Spirit Energy's existing marine procedures, including where applicable, the consent to locate process; • The vessels' work programme will be optimised to minimise vessel use; • There is a comprehensive management and operational controls plan developed to minimise the likelihood of large hydrocarbon releases and to mitigate their impacts should they occur. These include the OPEP; • All vessels undertaking decommissioning activities will have an approved SOPEP; • Existing contractor management processes will be used to reduce environmental impacts and risks; • Offshore chemical use and discharge, and offshore oil discharges will be risk assessed and permitted under the Offshore Chemicals Regulations 2002 (OCR) and the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended) (OPPC) respectively; • A waste materials inventory will be prepared in advance of the works to inform waste management planning; • All waste management sites and waste carriers used will hold appropriate environmental and operating licences; and • Spirit Energy's management of change process will be followed should there be a change to the proposed scope.
Seabed disturbance
• All activities which may lead to seabed disturbance will be planned, managed and implemented in such a way that disturbance is minimised; • The careful planning, selection of equipment, and management and implementation of activities; • A debris survey will be undertaken at the completion of the decommissioning activities. Any debris identified as resulting from decommissioning activities will be recovered from the seabed where possible; • Optimise the area that requires an overtrawl assessment and explore the possible use of sidescan sonar instead of fishing gear, through discussion with the relevant fishing organisations and the regulator.
Large Releases to Sea
• Releases, including potential large hydrocarbon releases, will be managed under the existing OPEP. The OPEP will be updated with details of any additional hydrocarbon inventory brought in to the field by the decommissioning activities; • All vessel activities will be planned, managed and implemented in such a way that vessel durations in the field are minimised; and, • Spirit Energy's existing marine procedures will be adhered to minimise risk of hydrocarbon releases.

Table 8.1.1: Summary of proposed control and mitigation measures

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APPENDIX A: SUMMARY OF WASTE LEGISLATION

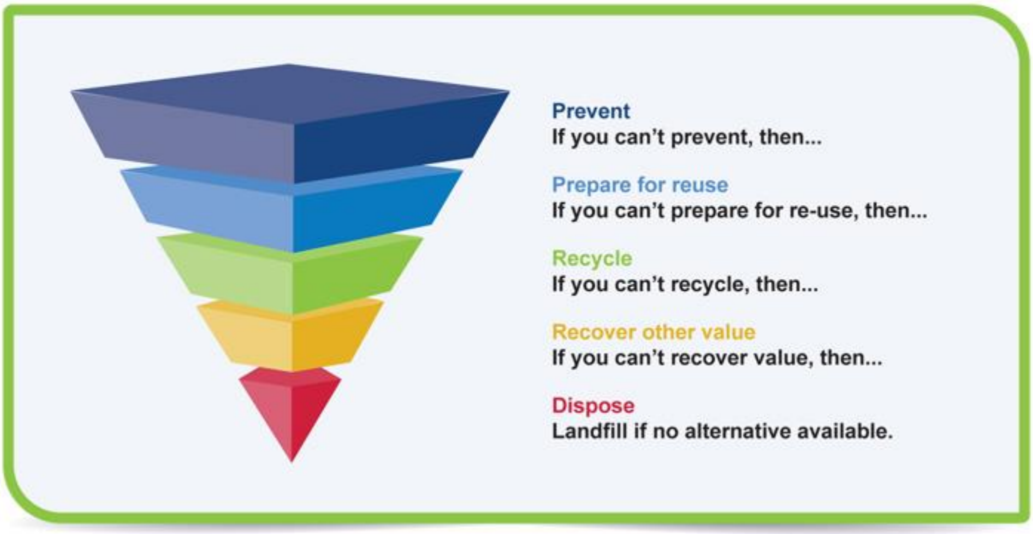
The revised Waste Framework Directive (Council Directive 2008/98/EC) was adopted in December 2008 with European Union (EU) Member States being required to implement revisions by December 2010. The overriding aim is to ensure that waste management is carried out without endangering human health and without harming the environment. Article 4 also states that the waste hierarchy shall be applied as a priority order in waste prevention and management legislation and policy.

The Waste (England and Wales) (Amendment) Regulation 2012 outline the requirement for collection, transport, recovery and disposal of waste. They set out the principles of the waste hierarchy which should be considered when treating and handling waste. In addition, OPRED guidance notes (OPRED, 2011), under the Petroleum Act 1998, require all decommissioning decisions to be made in line with the waste hierarchy.

Whether a material or substance is determined as a 'waste' is determined under EU law. The EU Waste Framework Directive defines waste as:

"*any substance or object which the holder discards or intends or is required to discard*".

Materials disposed of onshore must comply with the relevant health and safety, pollution prevention, waste requirements and relevant sections of the Environmental Protection Act 1990. The waste management assessment should be based on the worst case and follow the hierarchy shown below, in line with relevant legislation, permits and consents.



Waste hierarchy

Management of radioactive materials is governed under:

- Radioactive Substances Act 1993;
- Transfrontier Shipment of Radioactive Waste and Spent Fuel Regulations 2008; and
- The handling and disposal of radioactive waste requires additional authorisation.

Onward transportation of waste or materials must also follow applicable legislation, such as the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, a highly prescriptive regulation governing the carriage of dangerous goods by road.

APPENDIX B: IMPACT AND RISK MATRICES

B1 Impact Assessment Matrix

							Benefit	**Duration of harmful effect / recovery** (c. 80% of damage rectified)				
Habitats / species, land and air								within 1 month	within 1 year	≤3 years	>3 years or >2 growing seasons	>20 years
Surface water (any harm of drinking water source or ground water would be cat 4 or above)								Immediate	< 1 month	≤1 years	>1 year	>10 years
Reinstatement of Built Environment - Can be repaired								immediately	in <1 year	in <3 years	in >3 years	Cannot be rebuilt
Recovery for Societal - Decrease in the availability or quality of a resource								Access immediately	Short term decrease	Medium term decrease	Medium to long term decrease	Long term decrease
Habitats / Species	**Air**	**Soil or sediment**	**Water**	**Built Environment**	**Societal**		+1	1	2	3	4	5
Large area of habitat and/or large number or proportion of population or species impacted.	Large increase in contaminants in the air exceeding quality limits	Large area with contamination resulting in hazardous soil to humans (e.g. skin contact) or the living environment, remediation available (but difficult).	Drinking water standards breached for a large number of properties. Large groundwater body effected. Large water body exceeds a water quality guideline or objective.	Complete destruction of an area of built importance	Large population with high dependence on the impacted resource or large loss for other users.	5	-	6 Minor	10 Moderate	15 Significant	20 Major	25 Catastrophic
Moderate area of habitat and/or moderate number or proportion of population or species impacted.	Moderate increase in contaminants in the air exceeding quality limits.	Moderate area with contamination sufficient to be environmental damage[1] or in alignment with contaminated land legislation.	Drinking water standards breached for a moderate number of properties. Moderate groundwater body effected. Moderate water body exceed a water quality guideline or objective.	Loss of integrity to an area of built importance or nationally registered building leading to de-registering / categorisation with a need for remedial / restorative work.	Moderate population with moderate dependence on the impacted resource or moderate loss for other users.	4	-	4 Negligible	8 Minor	12 Moderate	16 Significant	20 Major
Small area of habitat impacted and/or small number or proportion of population or species impacted.	Small Increase in contaminants in the air exceeding quality limits	Contamination not leading to environmental damage	Drinking water standards breached for a small number of properties. Small groundwater body effected. Small water body exceed a water quality guideline or objective.	Loss of integrity to an area of built importance or nationally registered building with a need for remedial / restorative work.	Small population with small dependence on the impacted resource or small loss for other users.	3	-	3 Negligible	6 Minor	9 Minor	12 Moderate	15 Significant
Change is within scope of existing variability (or acceptable mixing zone) but potentially detectable or all within the site boundary / 500m zone (78.5 hectares).		Loss of integrity to an area of built importance or nationally registered building need for remedial / restorative work.		A small population with some dependence on the impacted resource. Negligible loss to other users.		2	-	2 Negligible	4 Negligible	6 Minor	8 Minor	10 Moderate
Effects are unlikely to be noticed or detectable.						1	-	1 Negligible	2 Negligible	3 Negligible	4 Negligible	5 Negligible

Low	Impact broadly acceptable and considered 'as low as reasonably practicable'	High	Impact intolerable. Control and mitigation measures required to reduce impacts to 'as low as reasonably practicable' and at least Medium
Medium	Impact is tolerable but to be managed to 'as low as reasonably practicable'	P	Positive – Positive or beneficial impact

[1] Damage is defined as per the EU Environmental Liability Directive or equivalent

B2 Risk Assessment Matrix

The translation for the impact table to the severity scale is as shown below.

IMPACT ASSESSMENT TABLE			RISK ASSESSMENT MATRIX[2]	
SCALE of IMPACT	**Severity ranking**	**Equivalent to**	**Consequence Scale**	**ENVIRONMENTAL DESCRIPTION (N/A to built environment or societal)**
Catastrophic (25)	H	➡	6	**Catastrophic** environmental impact which is widespread or affects a highly sensitive valuable environment requiring long term remediation.
Major (20)	H	➡	5	**Major** environmental impact to regional or high value environment requiring protracted remediation.
Significant (15-16)	H	➡	4	**Significant** environmental impact on local area. Long term natural recovery or moderate remediation intervention.
Moderate (10-12)	M	➡	3	**Moderate** environmental impact in neighbouring area. Longer term natural recovery or minor remediation intervention.
Minor (6-9)	M	➡	2	**Minor** environmental impact on site or to lower value environment with short term natural recovery.
Negligible (1-5)	L	➡	1	**Negligible** environmental impact.

Risk Assessment Matrix		Frequency (per yr) and Likelihood					
		$\leq 1x10^{-5}$ Highly Unlikely	$>1x10^{-5}$ to $1x10^{-4}$ Very Unlikely	$>1x10^{-4}$ to $1x10^{-3}$ Unlikely	$>1x10^{-3}$ to $1x10^{-2}$ Possible	$>1x10^{-2}$ to $1x10^{-1}$ Moderately Likely	$> 1x10^{-1}$ Likely
Consequences – Environment (E)		1	2	3	4	5	6
Catastrophic environmental impact which is widespread or affects a highly sensitive / valuable environment requiring long term remediation.	6	6	12	18	24	20	36
Major environmental impact to regional or high value environment requiring protracted remediation.	5	5	10	15	20	25	30
Significant environmental impact on local area. Long term natural recovery or moderate remediation intervention.	4	4	8	12	16	20	24
Moderate environmental impact in neighbouring area. Longer term natural recovery or minor remediation intervention.	3	3	6	9	12	15	18
Minor environmental impact on site or to lower value environment with short term natural recovery.	2	2	4	6	8	10	12
Negligible environmental impact.	1	1	2	3	4	5	6

[2] Spirit Energy Risk Assessment Matrix CEU-HSEQ-GEN-GUI-0051