# Laverda Field Development

# Environmental Statement

BEIS Reference: D/4230/2018

Premier Document Reference: AB-CN-PMO-HS-SE-RP-001

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PremierOil

## APPROVAL PAGE

| NAME | POSITION | PURPOSE | SIGNATURE | DATE |
|---|---|---|---|---|
| M O'Sullivan | Consultant Environmental Engineer (Genesis) | Author | Martha O'Sullivan | 12/12/18 |
| Liz Diplock | Env Advisor | Checker | EDiplock | 12/12/18 |
| Andy Foster | Env Lead | Approver | | 12/12/18 |

## REVISION HISTORY

| Revision | Issue Date | Status | Author | Approver |
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## DOCUMENT REVISION RECORD

| Rev. No. | Revised Section | Paragraph No. | Description of Changes |
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| **Project Name** | Laverda Field Development | |
| **Development Location** | Block 28/04a and 28/9d (field location) and 28/9a (drilling location) | |
| **Licence No** | P2070 | |
| **Project Reference No** | D/4230/2018 | |
| **Type of Project** | New Tie-back Development | |
| **Undertaker** | Premier Oil UK Ltd<br>Upper Denburn House, Prime Four Business Park, Kingswells, Aberdeen AB15 8PU | |
| **Licensees/Owners** | **Co-venturers** / **% Holding**:<br>Premier Oil Plc. – 54<br>Dyas UK Limited. – 10<br>Cairn Energy Plc. – 36 | |
| **Short Description** | The Laverda Field will be developed as a single well subsea tie-back to the existing Catcher Area Development infrastructure, using the processing and export facilities of the BW Catcher Production Storage and Offloading (FPSO) further downstream. The well will be drilled at a drilling template located *c*. 2.4 km from the existing infrastructure. New subsea lines to be installed include: a production flowline, a gas lift flowline and an electro hydraulic controls umbilical. All lines will be *c*. 2.4 km and will be protected with two rock berms. | |
| **Key Dates** | **Activities** / **Date**:<br>Drilling – Q2 – Q4 2020<br>Subsea installation – Q2 – Q4 2020<br>Well tie-in and commissioning – Q4 2020<br>First production – Q1 2021 | |
| **Significant Environmental Effects Identified** | The Environmental Statement (ES) assesses the worst-case impact of the project on the environment and is therefore very conservative. Even then, applying the mitigations measures identified, it is the conclusion of this ES that the current proposal for the Laverda Field Development can be completed without causing any significant long term environmental impacts or cumulative and transboundary effects. | |
| **Statement Prepared by** | Premier Oil UK Ltd and Genesis Oil and Gas Consultants Ltd. | |
| **Company** | **Job Title** | **Relevant Qualifications/Experience** |
| **Premier Oil UK** | Environmental Lead, Catcher Project | 25 years in industry |
| **Genesis Oil and Gas Consultants Ltd.** | Consultant Environmental Engineer | 20 years’ working in environment/oil and gas |
| | Consultant Environmental Engineer | 16 years’ working in environment/oil and gas |

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# NON-TECHNICAL SUMMARY

## BACKGROUND

The Catcher Area Development is located in Block 28/9 of the Central North Sea (Figure 1). Production at the Development commenced in December 2017 and it currently comprises three discoveries: Catcher, Varadero and Burgman tied back to the BW Catcher Floating Production Storage and Offloading (FPSO) vessel. From the FPSO, oil is exported via shuttle tanker and gas is exported via a gas pipeline tied into the Fulmar A to St Fergus gas pipeline. BW Offshore Catcher (UK) Limited are Installation Operator for BW Catcher FPSO.

Two further areas of expansion have been identified within the Catcher Area Development: Laverda and Catcher North.

Premier Oil UK (hereafter referred to as POUK), on behalf of itself and its partners, are proposing to develop the Laverda Field with one production well, drilled from a single drilling template termed the Catcher North Drilling Template (CNDT). The CNDT will be located mid-way between the Laverda and Catcher North Fields and will be tied back to the existing Varadero manifold. The CNDT will be located in Block 28/9, c. 175 km southeast of Aberdeen and c. 104 km west of the UK/Norway median line (Figure 1).

Development of the Laverda Field is captured within this Environmental Statement (ES).

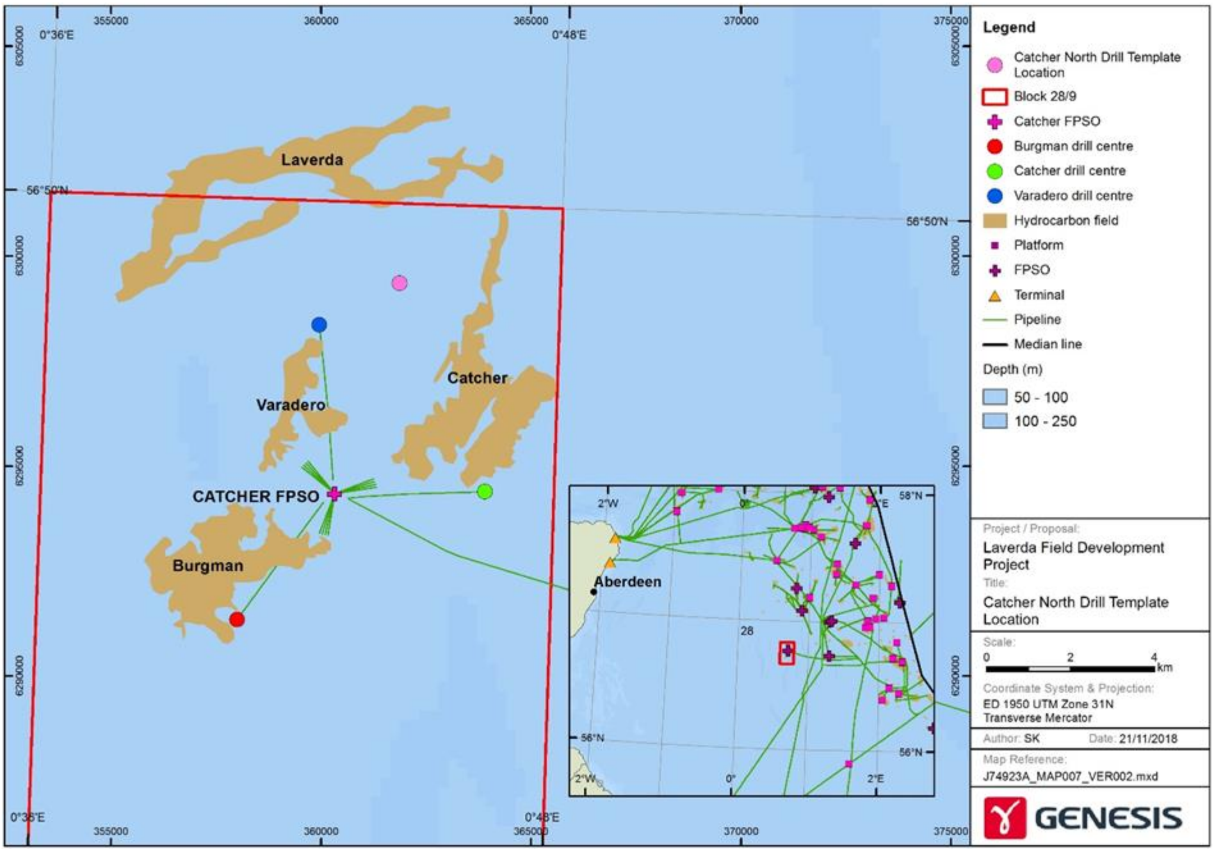


**Figure 1 Chart Showing Location of the Laverda Field.**

## ENVIRONMENTAL STATEMENT SCOPE

Approval to install the CNDT has been applied for under Master Application Template (MAT) DRA/616, such that the impacts associated with template installation are not considered further in this ES. Furthermore, the development of the Catcher North Field does not trigger the requirement for an ES under the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended).

The scope of the ES is therefore limited to the following activities:

1. Drilling of the Laverda production well;
2. Installation and commissioning of a production flowline, gas lift flowline and an Electro Hydraulic Controls (EHC) umbilical to be laid between the CNDT and the existing Varadero manifold.
3. Increased production at the BW Catcher FPSO; and
4. Decommissioning at end of field life.

## OPTION SELECTION

A number of development options were considered for the proposed Laverda Field Development, with the aim of optimising the value of the field and the surrounding infrastructure, through a safe and environmentally responsible development, incorporating justified opportunities and accounting for risks and capital exposure. Early on in Option Selection, it was determined that drilling of both the Laverda and Catcher North wells from the same drilling template was the preferred option, as a result of the minimal subsea infrastructure requirements, safety concerns, environmental impacts (e.g. seabed footprint) and Capital Expenditure (CAPEX) associated with it.

Three tie-back options were considered

- Tie-back directly to the BW Catcher FPSO;
- Tie-back to the manifold at the Catcher Field; and
- Tie-back to the manifold at Varadero

Tie-back to the manifold at Varadero was selected for a number of reasons, including the fact that this option has the shortest flowlines and EHC umbilical associated with it (*c*. 2.4 km).

In order to mitigate potential impacts from interaction with trawl gear, the selected solution was for the flexible flowlines and EHC umbilical to be surface laid and protected from trawl gear impacts using rock cover along the main lengths. Mattresses will also provide additional protection at the exposed ends (approaches and tie-in points), located wholly within the 500 m zones. Due to the proposed optimised schedule, trench and burial of the flowlines and umbilical was not considered practicable as this option would result in unnecessary health, safety and environmental risks from potential collision impacts and accidental damage.

Protecting the installed flowlines and the EHC umbilical under a single rock berm was not considered practicable, due to the excessive size (and large quantities of rock) required to achieve the required berm profile. A combination of geotechnical, buckling and flow assurance studies have confirmed that the optimal protection solution is to use two rock berms: one to protect the production flowline and EHC umbilical and one to protect the gas lift flowline.

## LAVERDA FIELD DEVELOPMENT PROJECT

The Laverda Field will be developed via a single development well drilled at the CNDT using a heavy duty jack-up (HDJU) drilling rig.

Production from the Laverda well will be transported to the existing Varadero production manifold via a new *c*. 2.4 km production flowline. A new *c*. 2.4 km gas lift flowline and a new *c*.2.4 km EHC umbilical (providing hydraulic, chemical, power and signals distribution to the new facilities) will also be laid between the CNDT and the existing Varadero manifold (Figure 2). As described above, the flowlines and EHC umbilical will be protected using two rock berms.

## SCHEDULE OF ACTIVITIES

The activities associated with the drilling, installation, and commissioning of the Laverda Field are scheduled to take place in Q2-Q4 2020, with First Oil in Q1 2021.

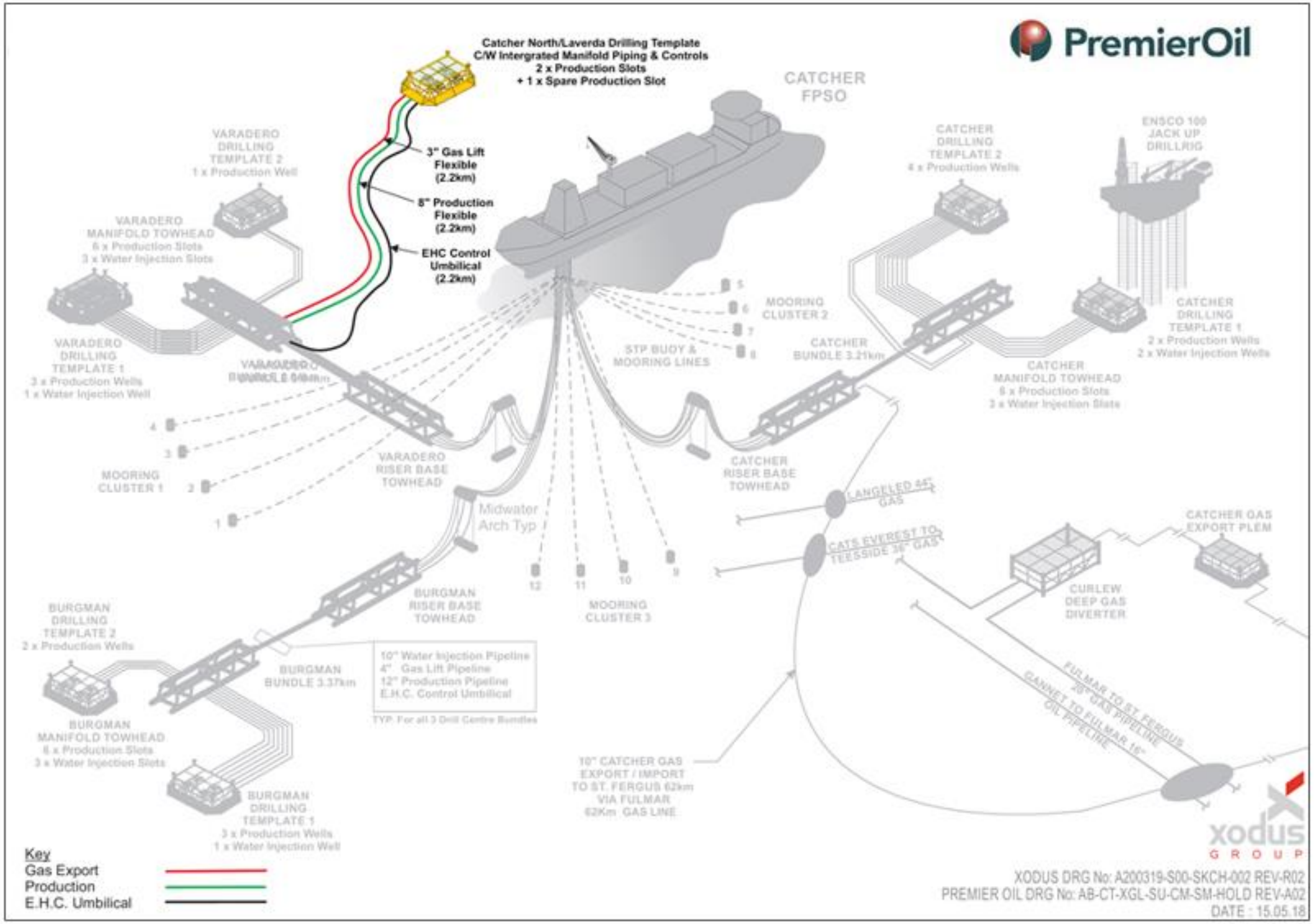


**Figure 2: Proposed CNDT Location and Associated Flowlines and EHC Umbilical in Relation to the Existing Catcher Area Development Infrastructure.**

## BASELINE ENVIRONMENT

The well and infrastructure associated with the proposed Laverda Field Development will be located in Block 28/9 of the CNS, in water depths ranging between *c.* 88 - 94 m Lowest Astronomical Tide (LAT).

The residual water flow in the CNS is typically 0.2 m/s towards the south, but water movement in the area is modified by tidal currents of up to *c.* 0.38 m/s. Waves propagate predominantly from the north with an annual mean significant wave height within the area between 2.1 - 2.7 m. During storms, the re-suspension and vertical dispersion of bottom sediments due to waves and currents, affects most of the North Sea.

Several environmental baseline surveys have been completed across the Catcher Area Development, and it has been agreed with the Department for Business Energy and Industrial Strategy (BEIS), that sufficient baseline information is available to support the EIA for the proposed Laverda Field Development.

The proposed Development is located within an extensive area of offshore circalittoral sands, and the seabed at the proposed CNDT location and at the Varadero drill centre is composed predominantly of fine slightly silty sand with shell fragments. There are patchy areas of coarser sediments characterised by an increased gravel component, and occasional pebbles and cobbles.

Plankton form the basis of the marine food chain, and in the area of interest the abundance of phytoplankton peaks in the spring, the community dominated by relatively large diatoms. There may be an additional, but smaller, peak in phytoplankton numbers during the autumn, with smaller dinoflagellate species dominating. Zooplankton peak in numbers during the summer period and are dominated by copepod species.

The area is characterised by benthic communities associated with offshore circalittoral sand, predominantly fine slightly silty sand with shell fragments. The infaunal communities are typical of moderate to low energy deep-water soft sediments in the CNS area, with a community dominated by small polychaete worms with *Paramphinome jeffreysii* and *Galathowenia oculata* the most abundant species. In some areas, the seabed is composed of a greater proportion of coarse materials in the form of shell and gravel, described as circalittoral mixed sediments. Occasional drop stones provide low energy circalittoral rock habitat, with attached epifauna such as hydroids and occasional cup corals. Other epifauna include sea pens, anenomes, urchins, tube worms, starfish, brittlestars, crabs and molluscs.

No Habitats Directive Annex I features were recorded by surveys of the area. The bivalve mollusc *Arctica islandica* is considered under threat and/or decline in the North Sea and a Priority Marine Feature (PMF) in Scottish waters has been recorded in the area, but is commonly found within the CNS. The nearest protected site is the East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA), which is located over 34 km from the proposed CNDT location and is therefore unlikely to be impacted by the planned activities.

Spawning and nursery grounds for fish species including cod, mackerel, lemon sole, Norway pout, blue whiting, haddock and sandeel have been identified in the area. Of the fish species known to occur in the area, blue whiting, Norway pout, sandeel and mackerel are PMFs in Scottish waters.

A number of seabirds are known to occur in the area, including common guillemot and Atlantic puffin at higher densities in the breeding season, and other species such as the black-legged kittiwake more common over the winter period. Based on the Seabird Oil Sensitivity Index (SOSI), the sensitivity of seabirds to surface oil pollution is generally considered low in the development area throughout most of the year, although seabird sensitivity is considered high and very high respectively, for the months of September and October in nearby areas to the south.

Cetacean species known to occur in the area of the Laverda Field Development include harbour porpoise, minke whale, white-beaked dolphin, white-sided dolphin and bottlenose dolphin. Harbour porpoise and white-beaked dolphin are most abundant. Grey seals are also expected to occur in low densities.

The area, defined by International Council for the Exploration of the Sea (ICES) rectangle 42F0, is of relatively low value to the UK fishing industry. Typically, demersal species dominate landings in terms of weight, however shellfish landings from the area have historically been more valuable, likely because targeted shellfish include species with a high market value.

Shipping density in the area is considered moderate. There are no renewable energy developments, aggregate extraction licences, submarine cables or military exercise areas in the vicinity of the proposed Laverda Field Development.

Surveys have identified three wrecks and one possible wreck in the Catcher Area Development. The nearest identified wreck is c. 4.4 km northwest of the proposed CNDT location.

## ENVIRONMENTAL IMPACT ASSESSMENT

In order to determine the impact that the proposed Laverda Field Development may have on the environment, an EIA was undertaken following a structured methodology.

For each of the planned activities, an environmental and/or social significance of impact was assigned for the relevant aspects (e.g. emissions to air, discharges to sea, underwater noise etc.) by considering the duration of the activities and the magnitude of the effect.

For unplanned events, the environmental and/or social significance of risk ranking also takes into account the magnitude of the effect. However, rather than considering the duration of the event, it takes account of the likelihood of the unplanned event occurring.

A summary of the key findings of the EIA and supporting impact assessment is presented here.

### Physical Presence

The physical presence of the project vessels, the drilling rig and the subsea infrastructure has the potential to be a navigational hazard, to restrict fishing operations in the area and/or to cause disturbance to wildlife. However, taking account of the mitigation measures outlined in Table 1, which includes early consultation with the Scottish Fisheries Federation, and notification to other users of the sea regarding the project’s activities, the significance of impact is considered medium and is therefore acceptable when managed within the mitigation measures described.

**Emission to Air**

Gaseous emissions can contribute to global atmospheric concentrations of greenhouse gases, regional acid loads and ozone depletion, with the main greenhouse gases being carbon dioxide, methane and nitrous oxide, all of which will be produced during the drilling, installation, commissioning and operational phases, of the proposed Laverda Field Development Project.

It is anticipated that, as a worst-case scenario, the average annual carbon dioxide emissions associated with the drilling rig during the drilling of the Laverda well, represents *c*. 0.26 % of the annual total UK mobile drilling rig combustion emissions. Average annual carbon dioxide emissions from other vessels required during the drilling phase (3,592 te) represent approximately 0.04 % of the annual UK domestic shipping emissions.

Carbon dioxide emissions from the subsea installation are anticipated to comprise 0.03 % of shipping (domestic and international) emissions.

Relative to other UKCS emissions associated with drill rigs, the significance of the environmental impact of emissions from the drilling rig is considered medium. When compared to shipping emissions, the environmental impact of emissions from vessels associated with the proposed activities is considered low. Therefore, taking account of the mitigation measures outlined in Table 1, the environmental impact of the emissions associated with the proposed development is considered acceptable, when managed within the mitigation measures described.

Increased production from the Laverda field will be used to fill FPSO ullage and reduce the rate of decline in the production profile. As a result, emissions to air from flaring and power generation are within the handling capacity of the FPSO.

**Discharges to Sea**

Planned and permitted discharges to sea during the drilling phase, include water based mud (WBM) and WBM contaminated cuttings, cement and associated chemicals. In this ES, reference was made to modelling previously carried out to support the Catcher, Varadero and Burgman ES (Premier, 2013). The impact of the discharge of the cuttings on the water column was considered short lived and not significant. Similarly, the discharge of cement from the drilling rig and those chemicals associated with the drilling operations were not considered to have a significant impact on the water column.

Previous modelling carried out to determine the impact of the discharge of cuttings at the other Catcher wells, was used to assess the impact of such discharges at the proposed Development. Given the nature and volume of the drilling muds and drill cuttings to be discharged, the comparatively small area of impact, the relatively rapid recovery rate of the water column and seabed and the absence of Annex I habitats or wrecks in the area of impact, the magnitude of the environmental effect of the discharge of cuttings is considered to be moderate, whilst the significance of the environmental impact is considered medium.

Planned and permitted discharges to sea during the installation and commissioning phase are primarily associated with testing the pipelines and infrastructure. All associated chemicals will be risk assessed and permitted in accordance with the Offshore Chemicals Regulations 2002 (as amended), such that the environmental impact of any discharges associated with the subsea installation and commissioning phase is considered low.

Incremental production from the Laverda Field will be used to fill FPSO ullage and reduce the rate of decline in the production profile. Therefore during production, the discharges from the BW Catcher FPSO will not exceed the FPSO capacity, such that the environmental impact of any discharges during this phase are considered low.

Given the relatively small scope of the proposed Development, the worst case environmental impacts of any discharges to sea are considered medium given POUK's commitment to the mitigation measures identified in Table 1**.**

**Seabed Disturbance**

A number of activities will be carried out which have the potential to impact on the seabed habitats, populated by the benthic communities in the area. A HDJU drilling rig will be used to drill the Laverda well. It is estimated that the maximum area of impact associated with positioning the drilling rig will be around 0.007 $m^2$. During installation of the subsea infrastructure including the flowlines, umbilical and protective structures, an area of seabed of *c*. 0.035 $km^2$ is expected to be permanently impacted.

Given the uniform nature of habitats within the Central North Sea, and the absence of any designating features in the proposed Development location, the environmental impact of any seabed disturbance is considered medium, given POUK's commitment to the mitigation measures identified in Table 1.

**Underwater Noise**

The main sources of underwater sound associated with the proposed Laverda Field Development will primarily result from vessel use and drilling operations. There will be no piling and no use of explosives. Note the impacts associated with piling of the CNDT have been assessed in the permit applications submitted under DRA/616.

Many marine organisms use sound for navigation, communication and prey detection. Therefore, the introduction of man-made sources of underwater noise has the potential to impact marine animals if it interferes with their ability to receive and use sound. Types of impact include temporary avoidance or behavioural changes, the masking of biological sounds, auditory and other injuries.

Although the sound from the proposed Laverda Field Development does have the potential to cause disturbance to marine animals, it is not expected to have a significant impact on any cetacean or fish species. Taking this into account, the environmental impact of the underwater noise associated with the proposed activities is considered to be medium, given POUK's commitment to the mitigation measures identified in Table 1.

**Waste**

POUK is committed to reducing waste production and to managing all produced waste by applying approved and practical methods. Waste will only be disposed of, if it cannot be prevented, reclaimed or recovered. A Waste Management Plan (WMP) will be developed for the Project and will identify (1) the types of waste generated and (2) management procedures for each waste stream. The Plan will detail appropriate waste contractors to be used to ensure the waste is correctly documented, transported, processed and disposed of in accordance with applicable legislation. A programme of regular audits will be carried out to verify correct implementation of the plan. The significance of the environmental impact of waste production during the drilling and installation phases, is considered medium given POUK’s commitment to the mitigation measures identified in Table 1. Relative to existing waste production at the BW Catcher FPSO during the production phase, there is no anticipated increase in waste, as a result of the proposed Laverda Field Development.

**Accidental Hydrocarbon Releases**

It was determined that a well blowout at the proposed Laverda well location, would result in a number of environmental receptors, including internationally protected areas being impacted such that the overall environmental impact of such a release is considered high.

However, in consideration of the control measures listed in Table 1, the likelihood of an accidental hydrocarbon release reaching its full effect potential, is considered to be reduced to as low as reasonably practicable. It should also be noted that should an uncontrolled release occur, there will be robust measures in place to ensure a co-ordinated and co-operative well control and pollution response campaign.

## OVERALL CONCLUSION

The proposed Laverda Field Development project will be developed using proven technology, incorporating the current best practices. A robust design, strong operating practices and a highly trained workforce, will ensure the proposed project does not result in any significant long-term environmental, cumulative or transboundary effects. Additional measures will be in place during the operating phase to effectively respond to potential emergency scenarios.

Where possible, mitigation measures to reduce the environmental and social risks have been identified (Table 1). These will be captured in the project’s Environmental Management Plan, which will include roles and responsibilities for their implementation.

**Table 1: Laverda Field Development Project Commitments.**

| Aspect | Commitments |
| --- | --- |
| **Physical presence** | • Ongoing consultation with SFF;<br>• Notice to Mariners will be circulated prior to rig mobilisation;<br>• Notice will be sent to the NLB of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the HDJU drilling rig;<br>• The HDJU drilling rig will abide by CtL conditions;<br>• A Collision Risk Management Plan will be produced;<br>• All vessels will adhere to COLREGS and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.;<br>• The HDJU drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore |

| Aspect | Commitments |
|---|---|
| | Installations;<br>• Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site;<br>• Flowlines will be designed in accordance with industry standards;<br>• A 500 m exclusion zone will be applied for at the CNDT location;<br>• The use of pipeline stabilisation features (e.g. mattresses, rock cover and grout bags) will be minimised through project design and will be used in accordance with SFF preferred practice.<br>• Size of rock and rock cover profiles will be in accordance with industry best practices. |
| **Emissions to air** | • The HDJU drilling rig will be subject to audits ensuring compliance with UK legislation;<br>• The impact from vessel emissions will be mitigated by optimising support vessel efficiency and minimising duration of activity;<br>• During drilling there will be adherence to good operating practices and maintenance programmes;<br>As Licensee, POUK will monitor and perform audits of BW Catcher to ensure:<br>• Emissions from combustion equipment are regulated through EU ETS and PPC Regulations. As part of the PPC permit the following measures will be in place:<br>• During production there will be adherence to good operating practices, maintenance programmes;<br>• The emissions from the combustion equipment will be monitored;<br>• Plant and equipment will be subject to an inspection and energy maintenance strategy;<br>• UK and EU air quality standards are not exceeded;<br>• Fuel gas usage will be monitored; and<br>• Energy assessments will be carried out as required. |
| **Discharges to sea** | • The HDJU drilling rig will be subject to audits ensuring compliance with UK legislation;<br>• All vessels used will be MARPOL compliant;<br>• Where technically feasible POUK will prioritise the selection of PLONOR, or chemicals with a lower RQ;<br>• The base case is for PW reinjection (reaching a minimum target of 95 % availability); and<br>• The discharges of PW and associated chemicals are regulated by the OPPC and OCR regulations and reported through the Environmental Emissions Monitoring Scheme (EEMS). During abnormal operations, PW sampling, analysis and reporting will be undertaken in line with the regulations and |

| Aspect | Commitments |
|---|---|
| | permit conditions. |
| **Seabed disturbance** | • Pre-deployment surveys will be undertaken to identify suitable locations for the drilling rig anchors;<br>• Use of dynamically positioned vessels; and<br>• The use of mattresses, rockdump and grout bags will be minimised through optimal project design. |
| **Underwater noise** | • Optimise duration of drilling and installation activities.<br>• No specific mitigation measures are recommended for the pipelay, drilling and vessel operations associated with the proposed project beyond good maintenance of equipment to reduce sound levels. |
| **Waste** | • POUK will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle;<br>• Existing asset and vessel WMPs will be followed;<br>• Only permitted disposal yards/landfill sites will be used. |
| **Accidental events** | • Activities will be carried out by trained and competent offshore crews and supervisory teams;<br>• An approved TOOPEP and OPEP will be in place prior to any activities being undertaken;<br>• Records will be kept of oil spill training and exercises as required by the TOOPEP and OPEP;<br>• A co-ordinated industry oil spill response capability will be available;<br>• Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue for POUK personnel;<br>Wells specific control measures:<br>• A robust BOP pressure and functional testing regime will be in place;<br>• Routine Remotely Operated Vehicle (ROV) inspections of the BOP on the seabed will be performed, as well as visual integrity checks whenever BOPs are recovered to the surface;<br>• Appropriate mud weights will be used to ensure well control is maintained;<br>• A contract will be in place with a well capping advice provider, in case of emergency;<br>Operations-specific control measures:<br>• Pipelines will be protected by pressure alarms and a leak detection system; and<br>• Oil spill control measures will be followed as outlined in the TOOPEP and OPEP. |

The ES assesses the worst case impact of the project on the environment and is therefore very conservative. Even then applying the mitigation measures identified, it is the conclusion of this ES that the current proposal for the Laverda Field Development can be completed without causing any significant long term environmental impacts, or cumulative and transboundary effects.

## ACRONYMS

| | |
|---|---|
| % | Percent |
| " | Inch (25.4mm) |
| °C | Degrees Celsius |
| µg/l | Microgram per litre |
| AHV | Anchor Handling Vessel |
| AIS | Automatic Identification System |
| ALARP | As Low As Reasonably Practicable |
| API | American Petroleum Institute |
| BAT | Best Available Technology |
| bbls | Barrels |
| BEIS | Department for Business, Energy and Industrial Strategy |
| BEP | Best Environmental Practice |
| BOD | Biochemical Oxygen Demand |
| BOP | Blowout Preventer |
| BWOCUK | BW Offshore Catcher (UK Limited) |
| CAPEX | Capital Expenditure |
| CATS | Central Area Transmission System |
| $CH_4$ | Methane |
| CMID | Common Marine Inspection Documents |
| CNDT | Catcher North Drilling Template |
| CNS | Central North Sea |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| COLREGS | International Regulations for the Prevention of Collisions at Sea |
| CoP | Cessation of Production |
| COSHH | Control of Substances Hazardous to Health |
| CR.LCR | Low Energy Circalittoral Rock |
| CRM | Collision Risk Management |
| CSIP | Cetacean Stranding Investigation Programme |
| CtL | Consent to Locate |
| DECC | Department of Energy and Climate Change |

| | |
|---|---|
| Defra | Department for Environment, Food and Rural Affairs |
| DepCon | Deposit Consent |
| DHSV | Downhole Safety Valve |
| DP | Dynamic positioning |
| DREAM | Dose-related Risk & Effect Assessment Model |
| DSV | Dive Support Vessel |
| DTI | Department of Trade and Industry |
| EC | European Commission |
| EEMS | Environmental Emissions Monitoring System |
| EHC | Electro Hydraulic Controls |
| EIA | Environmental Impact Assessment |
| EIF | Environmental Impact Factor |
| EPS | European Protected Species |
| ERRV | Emergency Response and Rescue Vessel |
| ES | Environmental Statement |
| ESAS | European Seabirds at Sea |
| ESDV | Emergency Shutdown Valve |
| EU | European Union |
| EU ETS | European Union Emissions Trading Scheme |
| FEAST | Feature Activity Sensitivity Tool |
| FPSO | Floating Production, Storage and Offloading |
| ft | Foot |
| GES | Good Environmental Status |
| GHG | Greenhouse Gases |
| H | Height |
| $H_2S$ | Hydrogen Sulphide |
| HDJU | Heavy Duty Jack Up |
| HP | High Pressure |
| HQ | Hazard Quotient |
| HSE | Health, Safety and Environment |
| Hz | Hertz |
| IAAP | International Air Pollution Prevention |

| | |
|---|---|
| IAMMWG | Inter-Agency Marine Mammal Working Group |
| ICES | International Council for the Exploration of the Seas |
| IMO | International Maritime Organisation |
| JNCC | Joint Nature Conservation Committee |
| kg | Kilogram |
| kHz | Kilo Hertz |
| km | Kilometres |
| $km^2$ | Square kilometres |
| L | Length |
| LAT | Lowest Astronomical Tide |
| LP | Low Pressure |
| LSA | Low Specific Activity |
| LTOBM | Low Toxicity Oil Based Mud |
| m | Metres |
| $m^2$ | Square Metre |
| $m^3$ | Cubic Metres |
| $m^3/d$ | Cubic Metres per day |
| MARPOL | Marine Pollution |
| MAT | Master Application Template |
| MCZ | Marine Conservation Zone |
| MDAC | Methane Derived Autogenic Carbonates |
| MEG | Monoethylene Glycol |
| MEMW | Marine Environmental Modelling Workbench |
| mg/l | Milligrams per litre |
| MoD | Ministry of Defence |
| mm | Millimetre |
| MMbls | Million Barrels |
| MMscf | Million Standard Cubic Feet |
| MODU | Mobile Drilling Unit |
| MPA | Marine Protected Area |
| m/s | Metres per second |
| MSDS | Material Safety Datasheet |

| | |
|---|---|
| MSFD | Marine Strategy Framework Directive |
| MU | Management Unit |
| n/a | Not Applicable |
| NCMPA | Nature Conservation Marine Protected Area |
| ng/l | Nanograms per litre |
| NLB | Northern Lighthouse Board |
| NMP | National Marine Plan |
| NMPI | Marine Scotland Maps |
| $N_2O$ | Nitrous Oxide |
| NOx | Nitrogen Oxides |
| NORM | Naturally Occurring Radioactive Material |
| OBM | Oil Based Mud |
| OCR | Offshore Chemicals Regulations |
| OGA | Oil & Gas Authority |
| OGUK | Oil & Gas UK |
| OiPW | Oil in Produced Water |
| OPEP | Oil Pollution Emergency Plan |
| OPPC | Oil Pollution, Prevention & Control |
| OSPAR | Oslo Paris Convention |
| OSRF | Oil Spill Response Forum |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PCB | Polychlorinated Biphenyl |
| PETS | Portal Environmental Tracking System |
| PLONOR | Pose Little Or No Risk to the Environment |
| PMF | Priority Marine Feature |
| POUK | Premier Oil UK Ltd |
| PPC | Pollution Prevention & Control |
| PW | Produced Water |
| PWA | Pipeline Works Authorisation |
| PWRI | Produced Water Reinjection |
| ROV | Remotely Operated Vehicle |
| RQ | Risk Quotient |

| | |
|---|---|
| SAC | Special Area of Conservation |
| SAT | Subsidiary Application Template |
| SCANS | Small Cetacean Abundance in the North Sea |
| SDM | Species Distribution Modelling |
| SFF | Scottish Fishermen's Federation |
| SIMOPS | Simultaneous Operations |
| SNH | Scottish Natural Heritage |
| SOPEP | Shipboard Oil Pollution Emergency Plan |
| SOSI | Seabird Oil Sensitivity Index |
| $SO_2$ | Sulphur Dioxide |
| SOx | Sulphur Oxides |
| SPA | Special Protection Area |
| SS.SMx.OMx | Circalittoral Mixed Sediments |
| SS.SSa.Osa | Offshore Circalittoral Sand |
| SSIV | Subsea Isolation Valve |
| te | Tonnes |
| te/day | Tonnes per day |
| te/hr | Tonnes per hour |
| THC | Total Hydrocarbons |
| TOOPEP | Temporary Operations Oil Pollution Emergency Plans |
| TVDSS | True Vertical Depth Subsea |
| UK | United Kingdom |
| UKBAP | UK Biodiversity Plan |
| UKCS | United Kingdom Continental Shelf |
| VOC | Volatile Organic Compounds |
| VTS | Vessel Traffic Survey |
| W | Width |
| WBM | Water Based Mud |
| WMP | Waste Management Plan |

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# 1 INTRODUCTION

As part of the Catcher Area Development, Premier Oil UK (hereafter referred to as POUK) on behalf of itself and its partners are proposing to develop the Laverda Field (Licence No. P2070). The field is located *c*. 165 km southeast of Aberdeen and *c*. 106 km from the UK/Norway median line, in water depths of *c*. 85 m Lowest Astronomical Tide (LAT) (Figure 1-1). The Laverda Field will be developed by a single production well, drilled from the shared Catcher North Drill Template.

This Environmental Statement (ES) has been produced in line with the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended), hereafter referred to as the EIA Regulations (see Section 1.5).

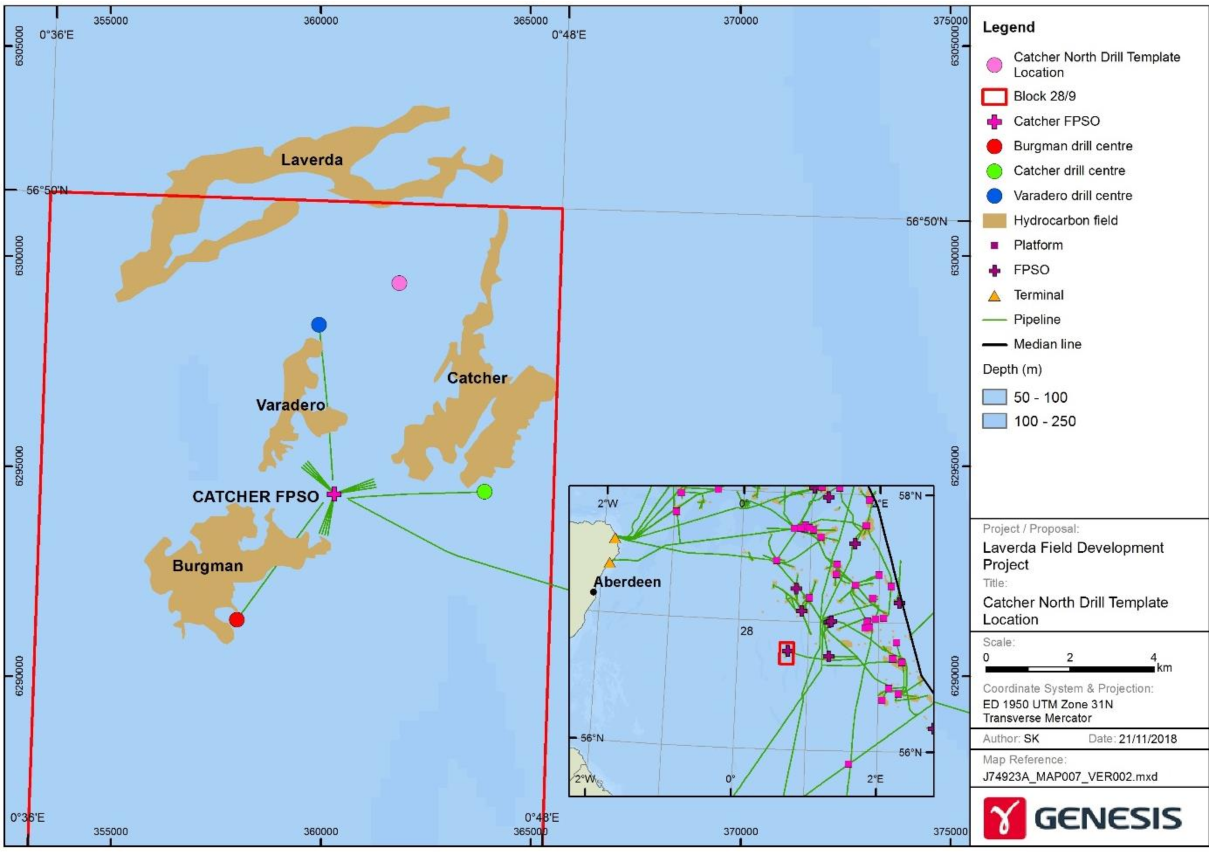



**Figure 1-1 Chart Showing Location of the Laverda Field.**

## 1.1 Background

The Catcher Area Development is located in Block 28/9 of the Central North Sea (CNS). Production at the Development commenced in December 2017 and it currently comprises three discoveries: Catcher, Varadero and Burgman tied back to the BW Catcher Floating Production Storage and Offloading (FPSO) vessel (Figure 1-2 and Figure 1-3). From the FPSO, oil is exported via shuttle tanker and gas is exported via a gas pipeline tied into the Fulmar A to St Fergus gas pipeline. BW Offshore Catcher (UK) Limited (hereafter referred to as BWOCUK Ltd) are Installation Operator for the BW Catcher FPSO.

Bathymetry, geotechnical surveys and drilling location assessments carried out during the early stages of the Catcher Area Development Project identified two areas of future expansion: Laverda and Catcher North. It is proposed to develop each of these fields with one production well (i.e. one well per field). The well for each field will be drilled from a single drilling template, termed the Catcher North Drilling Template (CNDT). The template will be located mid-way between the Laverda and Catcher North fields and will be tied back to the existing Varadero manifold as shown in Figure 1-3. The CNDT will be located in Block 28/9, *c*. 175 km south-east of Aberdeen and *c*. 104 km west of the UK/Norwegian median line.


**Figure 1-2: The BW Catcher FPSO.**

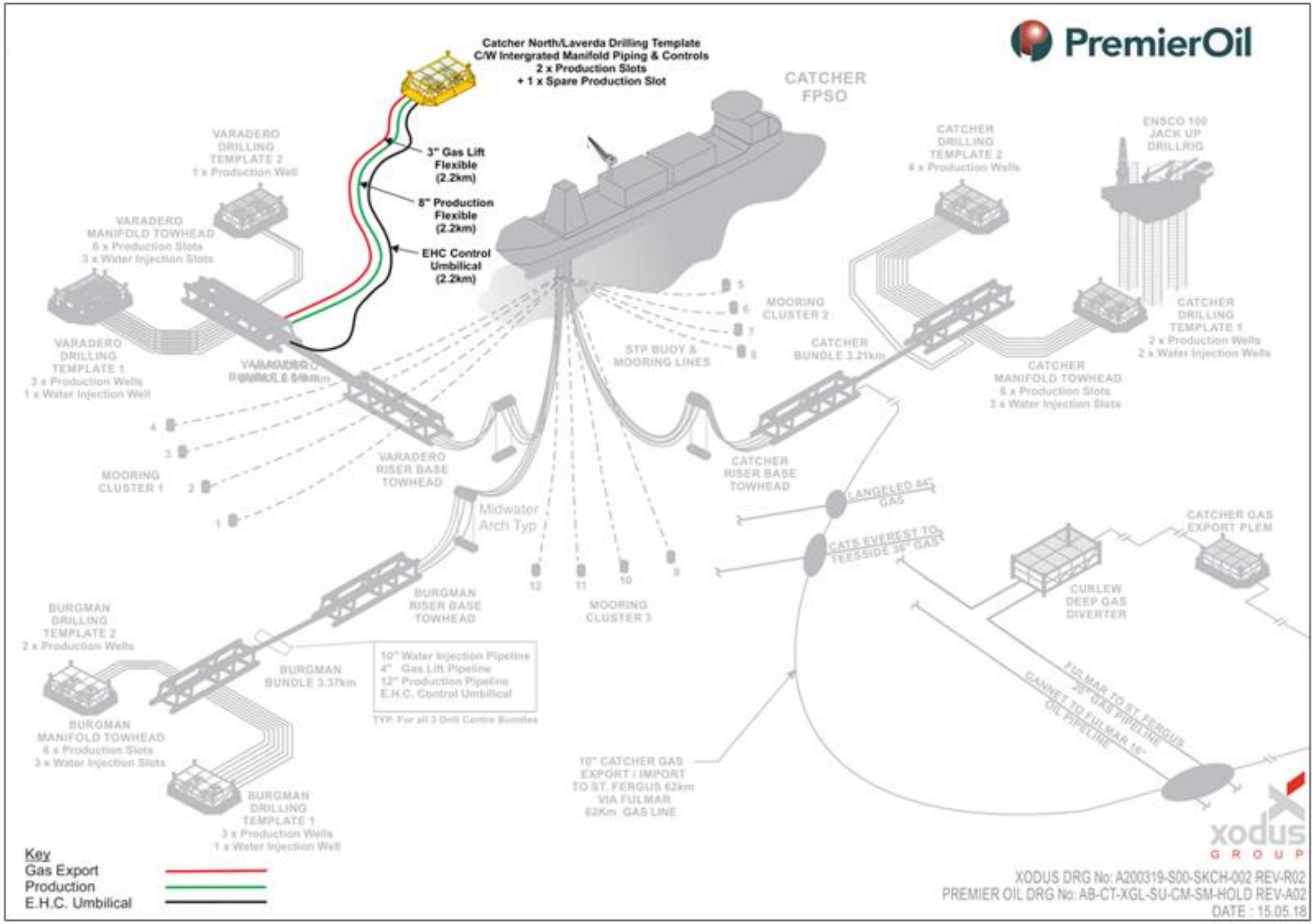



**Figure 1-3: Proposed Laverda and Catcher North Developments in Relation to the Existing Catcher Area Development Infrastructure.**

This ES focuses on the proposed Laverda Field Development, as an ES is not required for the Catcher North Field (see Section 1.5). However, as the Laverda and Catcher North wells will be drilled from the same template, reference is made to the development of the latter field, where necessary. Note the impacts associated with the Catcher North Field, will be captured under a series of permit applications prior to execution.

POUK is the Licence Holder and Well Operator of both the Laverda Licence (Block 28/4a: P2070) and the Catcher North Licence (Block 28/9a: P1430). The partners associated with these licences are listed in Table 1-1.

**Table 1-1 Ownership of the Laverda and Catcher North Fields.**

| Co-Venturers | Licence P1430* (Block 28/9a) % Ownership | Licence P2070 (Block 28/4a) % Ownership |
|---|---|---|
| Premier Oil Plc. | 50 | 54 |
| Dyas UK Limited. | 10 | 10 |
| Cairn Energy Plc. | 20 | 36 |
| MOL Group | 20 | - |
| *Also includes the Catcher, Varadero and Burgman fields. | | |

Incremental production for the Laverda (and Catcher North) field will be used to fill FPSO ullage and extend the production profile.

## 1.2 Purpose of the Environmental Statement

The EIA Regulations 1999 require the undertaking of an Environmental Impact Assessment (EIA) and production of an ES for certain types of offshore oil and gas projects likely to have a significant effect on the environment. The Regulations set trigger levels (see Section 1.5) for a mandatory EIA based on new or increased oil and gas production.

The purpose of this ES is:

- To report on the EIA process undertaken, to meet both statutory and POUK internal project requirements;
- To provide a public consultation document, which supports consultees in the decision-making process; and
- To provide an opportunity to reassure the Regulator and consultees, that POUK is informed and understands:
    - the likely consequences of the activities, emissions, discharges and physical presence of the project;
    - the local environment; and
    - the nature of the environmental and commercial issues arising from other users of the sea.

This ES has been prepared in accordance with the EIA Regulations and guidance from BEIS.

## 1.3 Scope of the Environmental Statement

The proposed Laverda and Catcher North Field Developments will together comprise:

1. The installation of a Drilling Template, CNDT, at a location that allows the well for each field to be drilled from a single location;
2. Drilling of the Laverda production well;
3. Drilling of the Catcher North production well;
4. Installation and commissioning of a production flowline, a gas lift flowline and an Electro-Hydraulic Controls (EHC) umbilical, between the CNDT and the existing Varadero manifold;
5. Increased production at the BW Catcher FPSO (relative to operations without the Laverda and Catcher North Fields); and
6. Decommissioning at end of field life.

Approval to install the CNDT has been applied for under Master Application Template (MAT) DRA/616, such that the impacts associated with template installation are not considered further in this ES[1]. Furthermore, development of the Catcher North Field does not trigger the requirement for an ES and therefore is out with the scope of this ES.

The scope of the EIA and resultant ES is therefore limited to the following activities:

1. Drilling of the Laverda production well;
2. Installation and commissioning of a production spool, gas lift spool and EHC umbilical jumper between the Laverda Xmas tree and existing production, gas lift and control facilities pre-installed within the Catcher North drill template. As a result, all Laverda well tie-in activities occur within the footprint of the Catcher North drill template;
3. Increased production at the BW Catcher FPSO (relative to operations without the Laverda Field); and
4. Decommissioning at end of field life.

Whilst not in scope of the Laverda ES, to address Stakeholder feedback during the preliminary consultation process, this document also includes:

- The results of the option selection process for the flowlines associated with the proposed tie-back to the existing Catcher area infrastructure; and
- Installation and commissioning of the Catcher North production flowline, gas lift flowline and an EHC umbilical between the CNDT and the existing Varadero manifold, into which hydrocarbons fluids from the Laverda field will be produced.

[1] Note the decision to assess the impacts associated with installation of the CNDT under a MAT application was agreed with BEIS.

## 1.4 Document Layout

To determine the environmental and socio-economic impacts of the proposed Laverda Field Development, an understanding of the regulatory context, stakeholder concerns, the proposed activities and the environmental and socio-economic baseline is required. Table 1-2 details the structure of the ES report.

**Table 1-2: Structure of the ES.**

| Section No. | Title | Contents |
|---|---|---|
| | Non-Technical Summary | A summary of the ES Report. |
| 1 | Introduction | Introduction to the project and scope of the ES. This chapter also includes a summary of applicable legislation, POUK's Management System, areas of uncertainty and the consultation process to date. |
| 2 | Project Description | A description of the drilling and subsea installation operations, an overview of the BW Catcher FPSO and the anticipated production profiles. |
| 3 | Environmental and Socio-Economic Baseline | A description of the environmental and socio-economic receptors in the area. |
| 4 | Risk Assessment Methodology | Description of the methodology used to determine the significance of the environmental and social risk of the proposed activities. |
| 5 to 10 | Assessment of Aspects | Detailed assessment of Physical Presence (Section 5); Emissions to Air (Section 6); Discharges to Sea (Section 7); Seabed Disturbance (Chapter 8); Underwater Noise (Section 9); and Waste Generation (Section 10). |
| 11 | Accidental Events | Assessment of the impact of accidental events identified during the EIA process |
| 12 | Conclusions | Key findings including a register of commitments. |
| 13 | References | Lists sources of information drawn upon throughout the ES. |
| Appendix A | Scotland's National Marine Plan | Assessment of the project against the Scotland's National Marine Plan. |
| Appendix B | EIA table | Summary table of EIA results. |

## 1.5 Legislative Overview

An overview of the current relevant legislation is provided here.

### 1.5.1 Environmental Impact Assessment

Offshore environmental control has developed significantly over the past thirty years and is continuing to evolve in response to increasing awareness of potential environmental impacts. Strands of both primary and secondary legislation, voluntary agreement and conditions in consents granted under the petroleum licensing regime and International Conventions have all contributed to the current legislative framework.

The main controls for new oil and gas projects are EIAs, which became a legal requirement of offshore developments in 1998. Current requirements are set out in the EIA Regulations and accompanying Guidance Notes for Industry (BEIS, 2018).

The EIA Regulations require an ES to be prepared and submitted for:

I. New developments, or an increase in production which will produce 500 te or more per day of oil, or 500,000 $m^3$ or more per day of gas;
II. Pipelines of 800 mm diameter and 40 km or more in length;
III. Storage sites pursuant to Directive 2009/31/EC on the geological storage of Carbon Dioxide ($CO_2$);
IV. Installations for the capture of $CO_2$ for the purpose of storage; and
V. Any change to or extension of projects listed in parts (i) to (iii) above where such a change, or extension in itself, meets the thresholds specified above.

In addition to the mandatory ES conditions, a discretionary ES may be required for an oil and gas project if, for example, the new development is less than 40 km from the UK coast. Such projects will be considered on a case-by-case basis. Further details are contained in the Guidance Notes for Industry (BEIS, 2018).

An ES is required for the proposed Laverda Field Development as the calculated production profiles suggest that the volumes referenced above will be exceeded during the first year of production (anticipated to be 2021 – see Section 2. 8 for P10 production profiles).

Following submission of the ES, a period of formal public consultation is required under both the EIA Regulations and European Directive 2003/35/EC (Public Participation Directive).

The EIA needs to consider the impact on the surrounding environment, including any protected areas. Protected areas have been designated as a result of European Directives, in particular the European Union (EU) Habitats Directive 92/43/EEC and the EU Wild Birds Directive 2009/147/EC (previously 79/409/EEC), and have been enacted in the UK by the following legislation:

- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended 2012) transpose the Habitats and Birds Directives into UK law. They apply to land and to territorial waters up to 12 nautical miles (nm) from the coast and have been amended a number of times.
- The Conservation of Habitats and Species Regulations 2010 (as amended 2012): These regulations consolidate all the various amendments made to the Conservation

(Natural Habitats, &c.) Regulations 1994 (above) in England and Wales. In Scotland, the Habitats and Birds Directives are transposed through a combination of the Habitats Regulations 2010 as amended (in relation to reserved matters) and the 1994 regulations as amended.

- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended 2009 and 2010) transpose the Habitats Directive and the Birds Directive into UK law in relation to oil, gas and, under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, Carbon Capture and Storage (CCS) plans and projects. The regulations apply to the UK's offshore marine area (i.e. outside the 12 nm territorial limit) and English / Welsh territorial waters.
- The Offshore Petroleum (Conservation of Habitats) Regulations 2001 (as amended 2007), similar to the Offshore Marine Conservation (Natural Habitats &c) Regulations, transpose the Habitats Directive and the Birds Directive into UK law in relation to oil, gas and under the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010, CCS plans and projects. These regulations apply to projects wholly or partially on the UKCS and adjacent waters outside territorial waters.

### 1.5.2 Protected Sites and Species

All offshore projects or developments must demonstrate that they are not "likely to have a significant impact on the integrity of the conservation objectives for the protected site", or "significantly disturb European Protected Species (EPS)" either alone, or in combination with other plans and projects.

The disturbance of EPS has been further defined by the 2010 amendments to the Offshore Marine Conservation Regulations. It is an offence to:

- Deliberately capture, injure, or kill any wild animal of an EPS (termed the injury offence); and/or
- Deliberately disturb wild animals of any such species (termed the disturbance offence).

Disturbance of an animal includes in particular any disturbance which is likely to:

- Impair the animal's ability to survive, breed, reproduce, to rear and nurture their young and, where applicable, an animal's ability to hibernate or migrate; and/or
- Significantly affect the local distribution or abundance of the species to which they belong.

### 1.5.3 Discharges to Sea

#### Oil Discharges

In line with the Oslo / Paris Convention (OSPAR) Recommendation (2001/1), the UK through BEIS has introduced regulatory requirements which reduce the permitted average monthly oil in water discharge concentration to a maximum of 30 mg/l. OSPAR Recommendation 2001/1 also required contracting parties to reduce the total discharge of oil in Produced Water (PW) by 15% by 2006, measured against a 2000 baseline. The permits replaced the granting of exemptions under the Prevention of Oil Pollution Act 1971 and are issued under the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended 2010 and 2011). This target has been met and maintained by the industry as a whole.

**Chemical Discharges**

In June 2000, the OSPAR Convention for the Protection of the Marine Environment in the North East Atlantic made a decision requiring a mandatory system for the control of chemicals (OSPAR Decision 2000/2 on a Harmonised Mandatory Control System for the Use and Reduction of the Discharge of Offshore Chemicals). This decision operates in conjunction with two OSPAR Recommendations:

- OSPAR Recommendation 2000/4: The application of a Harmonised Pre-Screening Scheme for Offshore Chemicals to allow authorities to identify chemicals being used offshore; and
- OSPAR Recommendation 2000/5: The application of a Harmonised Offshore Chemical Notification Format for providing data and information about chemicals to be used and discharged offshore.

The UK Government's offshore oil and gas regulator (BEIS) implemented OSPAR Decision 2000/2 on the control of chemical use offshore, through the Offshore Chemicals Regulations (OCR) (2002, as amended 2010 and 2011).

**Risk Based Approach**

OSPAR Recommendation 2012/5 for a Risk-Based Approach (RBA) to the Management of PW Discharges from Offshore Installations aims to produce a method for prioritising mitigation actions for those discharges and substances that pose the greatest risk to the environment. The objective is that by 2020 all offshore installations with PW discharges in the OSPAR maritime area will have been assessed to determine the level of the risk and that, where appropriate, measures will have been taken to reduce the risk posed by the most hazardous substances. BEIS has issued guidance on the RBA for UK installations (DECC, 2014).

### 1.5.4 Atmospheric Emissions

Combustion installations on oil and gas platforms with a rated thermal input of 20 MW (th) or more, require permitting under the EU's Emissions Trading Scheme (EU ETS) and implemented in UK regulations as the Greenhouse Gas ETS Regulations 2005 (as amended 2007). This includes the requirement to monitor and report $CO_2$ emissions, surrender allowances and to notify of any changes affecting the allocation of allowances.

Combustion installations on oil and gas platforms with a rated thermal input of 50 MW (th) or more, require permitting under the Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013. This includes conditions limiting releases, notably for carbon monoxide (CO), oxides of nitrogen (NOx), oxides of sulphur (SOx), methane ($CH_4$) and volatile organic compounds (VOCs) and the demonstration of the use of Best Available Technique (BAT).

### 1.5.5 Marine and Coastal Access Act

The Marine and Coastal Access Act (MCAA) came into force in November 2009. The Act covers all UK waters except Scottish internal and territorial waters which are covered by the Marine (Scotland) Act (2010), which mirrors the MCAA powers. Licensing provisions in relation to the MCAA came into force on 1st April 2011. The MCAA replaces and merges the requirements of the Food and Environmental Protection Act (FEPA) Part II (environment) and the Coastal Protection Act (navigation).

The following activities are exempt from the MCAA, as they are regulated under different legislation:

- Activities associated with exploration or production/storage operations, that are authorised under the Petroleum Act; and
- Additional activities authorised solely under the BEIS environmental regime, e.g. chemical and oil discharges.

Therefore, activities which are not regulated by the Petroleum Act or under the BEIS environmental regime require an MCAA licence as of April 2011.

The MCAA enables the designation of Marine Conservation Zones (MCZs) in the territorial waters adjacent to England and Wales and UK offshore waters. In Scotland, offshore MCZs are referred to as Nature Conservation Marine Protected Areas (NCMPAs) in order to be consistent with the designation of Marine Protected Areas (MPAs), within Scottish Territorial waters under the Marine (Scotland) Act.

### 1.5.6 National Marine Plan

The National Marine Plan (NMP) comprises plans for Scotland's inshore (out to 12 nautical miles) and offshore waters (12 to 200 miles) as set out under the Marine (Scotland) Act 2010 and the Marine and Coastal Access Act 2009. The NMP represents a framework of Scottish Government policies for the sustainable development of marine resources. The NMP is underpinned by strategic objectives:

- Achieving a sustainable marine economy;
- Ensuring a strong, healthy and just society;
- Living within environmental limits;
- Promoting good governance;
- Using sound science responsibly.

These objectives are to be achieved through the application of 21 'General Planning Principles'. Development projects should take these principles into account, in order to support the overall NMP objectives for sustainable development of Scotland's marine environment.

The NMP sets out specific key issues for oil and gas sector in supporting the objectives of the plan:

- Maximise extraction;
- Re-use infrastructure;
- Transfer of skills to renewables and CCS;
- Co-operation with the fishing industry;
- Noise impacts to sensitive species;
- Chemical and oil contamination of water, sediments and fauna;
- Habitat changes.

The NMP also sets out general policies and objectives as part of the UK's shared framework, for sustainable development. The proposed operations as described in this ES, have been assessed against all NMP objectives (Appendix A) and policies, but specifically GEN 1, 4, 5, 9, 12, 14 and 21:

**GEN 1- General Planning and Principle**

Development and use of the marine area should be consistent with the Marine Plan, ensuring activities are undertaken in a sustainable manner that protects and enhances Scotland's natural and historic marine environment.

**GEN 4 - Co–existence**

Where conflict over space or resource exists or arises, marine planning should encourage initiatives between sectors to resolve conflict and take account of agreements where this is applicable.

**GEN 5 - Climate Change**

Marine planners and decision makers should seek to facilitate a transition to a low carbon economy. They should consider ways to reduce emissions of carbon and other greenhouse gasses.

**GEN 9 - Natural Heritage**

Development and use of the marine environment must:

- Comply with legal requirements for protected areas and protected species.
- Not result in significant impact on the national status of Priority Marine Features (see Section 3.4); and
- Protect and, where appropriate, enhance the health of the marine area.

**GEN 12 – Water Quality and Resource**

Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply.

**GEN 14 – Air Quality**

Development and use of the marine environment, should not result in the deterioration of air quality and should not breach any statutory air quality limits. Some development and use may result in increased emissions to air, including particulate matter and gases. Impacts on relevant statutory air quality limits must be taken into account and mitigation measures adopted, if necessary, to allow an activity to proceed within these limits.

**GEN 21 – Cumulative Impacts**

Cumulative impacts affecting the ecosystem of the marine plan area, should be addressed in decision making and plan implementation.

These NMP policies and objectives have been considered during the development of the proposed project and when undertaking the EIA. An assessment of the proposed operations against the Scottish National Marine Plan criteria, is provided in Appendix A.

## 1.6 Environmental Management

POUK are committed to conducting activities in compliance with all applicable legislation and in a manner that will minimise impacts on the environment. The proposed Laverda Field Development will be delivered in compliance with the requirements of POUK's ISO 14001 certified Environmental Management System. Throughout the Project, POUK have and will continue to use the proprietary software 'PLANC Manager©' (Permits, Licences, Authorisations, Notifications and Consents) to track all relevant environmental permits, consents and notifications. POUK recognise that effective Health, Safety and Environmental (HSE) management contributes significantly to long term business success. POUK's HSES (Health, Safety, Environment and Security Policy) is provided in Figure 1-4.

PremierOil

# HEALTH, SAFETY, ENVIRONMENT AND SECURITY POLICY

Premier Oil is committed to operating responsibly and will never knowingly compromise our health, safety, environmental or security standards. We will do all that is reasonably practicable to reduce HSES risks, ensure the safety and security of everyone affected by our operations and protect the environment by minimising our environmental impacts.

To achieve this we will:

- *Provide strong, visible leadership and commitment at all levels of the Company;*
- *Effectively identify hazards, and assess and manage risks;*
- *Meet or surpass our legal and other requirements (compliance obligations);*
- *Set objectives and targets to drive improvement;*
- *Support and train our people and assure their competence;*
- *Provide appropriate resources;*
- *Encourage open and honest communication;*
- *Effectively manage the HSES risks associated with contracted work;*
- *Maintain clean, safe, healthy and secure workplaces;*
- *Maintain high quality documented systems and processes;*
- *Plan and prepare for potential emergencies;*
- *Report, investigate and learn from any incidents and near misses;*
- *Routinely inspect the workplace and audit systems and processes;*
- *Seek opportunities to continually improve our performance.*

It is the responsibility of everybody involved in Premier Oil to comply with our policies and to assist the Company in their implementation.

Tony Durrant

Chief Executive Officer, Premier Oil plc
July 2018

**Figure 1-4 POUK's HSES Policy.**

## 1.7 Areas of Uncertainty

This ES was prepared during the design stage for the proposed project. As a result, some assumptions have been made in order to undertake the EIA. Where assumptions have been made, the environmentally 'worst case' option was assessed. Assumptions and uncertainties are outlined below.

### 1.7.1 Production Profiles

Production profiles based on models have a degree of uncertainty associated with them. The production profiles presented in this ES are based on a high case and are an annualised average of the projected production from the Laverda Field Development.

### 1.7.2 Rock Cover, Mattresses and Grout Bags

Maximum anticipated quantities of rock cover, mattresses and grout bags are presented to assess the worst case scenario in terms of impacts on the seabed. The requirements for rock cover, mattresses and grout bags will be further assessed and confirmed in later Pipeline Work Authorisation (PWA) and Deposit Consent (DepCon) applications and their supporting environmental permit applications which will be submitted under a Pipeline MAT application.

## 1.8 Consultation Process

During the process to assess the environmental impact of the proposed Laverda Field Development, POUK consulted a number of organisations (Table 1-3). The process of consultation will continue throughout the project.

**Table 1-3: Summary of Consultations.**

| Issue/Concern/Outcome | POUK Response |
|---|---|
| POUK met with BEIS to discuss the contents of the ES on 5/10/18 | |
| It was agreed at the meeting that POUK would submit a drilling application for the Catcher North well, that would initially cover the Consent to Locate for the installation of the CNDT. The other applications relating to the Catcher North well will be added at a later date.<br>This ES will therefore not require assessment of the impacts associated with installing the CNDT and will focus on drilling of the Laverda well, tie-in of the flowlines and umbilical, incremental production at the BW Catcher FPSO and decommissioning. | Consent to Locate permit application has been submitted to BEIS under DRA/616. |
| POUK met with the Scottish Fishermen's Federation (SFF) to inform them of the project on 18/10/18 | |
| Discussion was held regarding rock berm and the preferred separation distance between the two berms. SFF advised that 50 m is the preferred separation distance.<br>POUK advised SFF that an Emergency Response and Rescue Vessel (ERRV) will be on site at the drilling location whilst the subsea installation activities are progressing. Therefore, it is not expected that a guard vessel specifically associated with the subsea installation activities will be required.<br>Prior to execution, consideration will be given to the requirement for a Fisheries Liaison Officer (FLO) on the construction vessel, though at the time of writing it was not expected that one would be required. | Rock berm details are provided in Section 2.6.2. |
| Response from Marine Scotland Science (MSS) to email inviting feedback on the proposed project (email sent on 22/10/18) | |
| MSS request that a summary table of any feedback received from stakeholders is included in the ES and detail provided as to how any feedback been addressed. | Presented in this table. |
| MSS requests that the ES discusses how the proposed works comply with Scotland's National Marine Plan. | Appendix A. |
| MSS would ask that an option selection and alternatives section is included in the ES which should discuss how the proposed development (including pipeline route and installation options) represent Best Environmental Practice (BEP) using BAT.<br>MSS advise that the option selection process takes account of the lifecycle of the project and future decommissioning. MSS recommend that alignment of the project with the SFF Offshore Oil and Gas Decommissioning Policy and Key Principles documents would benefit from being discussed: https://www.sff.co.uk/sff-offshore-oil-gas-decommissioning-policy/. | Option selection process presented in Section 2.3. |
| MSS request that a detailed schedule of works is provided with any contingency periods identified. | Presented in Section 2.4. |
| MSS advise that cementing operations are presented and associated environmental / socio economic impacts are assessed. | Section 2.5.5 and 7.1.2. |
| MSS advise an upfront overview of any potential concerns from a chemical discharge perspective and compatibility with the host facility should be included. | Section 2.8. |
| MSS advises inclusion of an outline of the nature of the expected hydrocarbons is included. | Section 2.2. |

| Issue/Concern/Outcome | POUK Response |
|---|---|
| MSS provided a number of data sources for reference with respect to describing the environmental and socio-economic baselines. | Data sources referenced where relevant. |
| MSS requests that Priority Marine Features are considered in the ES. | Section 3.4. |
| MSS advise that a systematic impact assessment methodology is applied to allow impacts to be ranked. | Section 4. |
| MSS advise that the impact of unplanned hydrocarbon releases should take account of aquaculture and Shellfish Water Protected Areas. | Section 11 |
| MSS advise that the potential for in-combination, cumulative and transboundary impacts are discussed in the ES. | Addresses in chapters 5 to 11. |
| MSS request that details of whether the proposed well will be fitted with fishing friendly / overtrawlable structures is provided. | The wells will be drilled at a template with a 500 m exclusion zone in place. |
| MSS The predicted effectiveness of the stated mitigation measures should be made clear, and the ES should demonstrate a firm commitment to implementing the proposed measures. MSS note they would find a tabulated summary of the mitigation measures useful. | Tabulated summary included in the Executive Summary and repeated in the Conclusions chapter. |
| MSS recommends that the ES considers decommissioning upfront and details how all installed infrastructure / protective material would be removed should this be the policy in place at that time. | Addressed in the Section 2.10. |
| MSS requests the inclusion of a comprehensive conclusion summarising the main environmental sensitivities and how these are to be mitigated or why they are not considered to be significantly affected. | Conclusion presented in Section 12. |
| Response from the Joint Nature Conservation Committee (JNCC) to email inviting feedback on the proposed project (email sent on 22/10/18) | |
| JNCC request justification for selected pipeline installation option. JNCC encourage POUK to work towards minimising the amount of hard substrate introduced to what is considered a mainly sedimentary environment. | Option selection process presented in Section 2.3. |
| With respect to the stabilisation features JNCC request the following information:<br>• Location of dump sites<br>• Size/grade of rock to be used<br>• Tonnage/ volume of rock to be used<br>• Contingency tonnage / volume to be used<br>• Method of delivery to the seabed<br>• Footprint of rock<br>• Assessment of the impact<br>• Expected fates of deposit after end of production. | Information on rock cover presented in Section 2.6.2. Impact assessment presented in Section 8. |
| Response from the Health and Safety Executive to email inviting feedback on the proposed project (email sent on 22/10/18) | |
| HSE replied to say they had no comments on the proposed Laverda Field Development. | No action required. |
| Note an email providing a summary of the project was also sent to the SFF and BEIS (email sent on 22/10/18). No response was received to the email, though feedback had previously been received from SFF and BEIS at the meetings detailed in the first part of this table. | |

# 2 PROJECT DESCRIPTION

## 2.1 Introduction

POUK proposes to develop the Laverda Field via the drilling of a single (subsea) development well which, along with an adjacent development well to be drilled into the Catcher North field, will be tied-back to the existing Varadero infrastructure. The Laverda well will be drilled at the CNDT. Approval to install the CNDT has been applied for under MAT DRA/616, such that the installation of the template is not considered further in this ES.

Production from the Laverda well will be transported to the existing Varadero (bundle) production manifold, via a new 8” production flowline. A new 3” gas lift flowline and a new EHC umbilical (providing hydraulic, chemical, power and signals distribution to the new facilities), will also be laid between the CNDT and the existing Varadero manifold. Further details are provided in subsequent sections.

## 2.2 Nature of Reservoir

The Laverda Field is an oil field located to the north of the Varadero Field (Figure 2-1). The reservoir has a True Vertical Depth Subsea (TVDSS) range between -3,800 ft (-1,158 m) and -4,600 ft (-1,400 m). Similar to the nearby fields (e.g. Catcher, Varadero and Burgman), the Laverda reservoir is of Late Paleocene/Early Eocene age, with the hydrocarbons trapped within the Tay Sandstone. The Cromarty Sandstone is hydrocarbon bearing in the Catcher Field, but not in Laverda.

The Tay reservoir in Laverda has been interpreted as a predominantly injectite[1] reservoir sharing the same emplacement mechanism and reservoir architecture as the other Catcher area reservoirs. The Cromarty Sandstone is present in the area and is interpreted to be the parent beds to the Tay Sandstone injectites. It is also possible that the Laverda reservoir is predominantly an injectite reservoir sourced from a Tay turbidite[2] channel, but this does not materially change the reservoir interpretation.

Reservoir quality is expected to be excellent and similar to the other Catcher Area reservoirs. Characteristics for the Laverda reservoir are summarised in Table 2-1.

Total recoverable volumes of oil from the Laverda field is anticipated to be around 2.8 mmbls (P50).

[1] Injectites are structures/reservoirs formed by sediment injection.
[2] A turbidite is a geologic deposit of a turbidity current, which is a type of sediment gravity flow responsible for distributing vast amounts of sediment in the ocean.

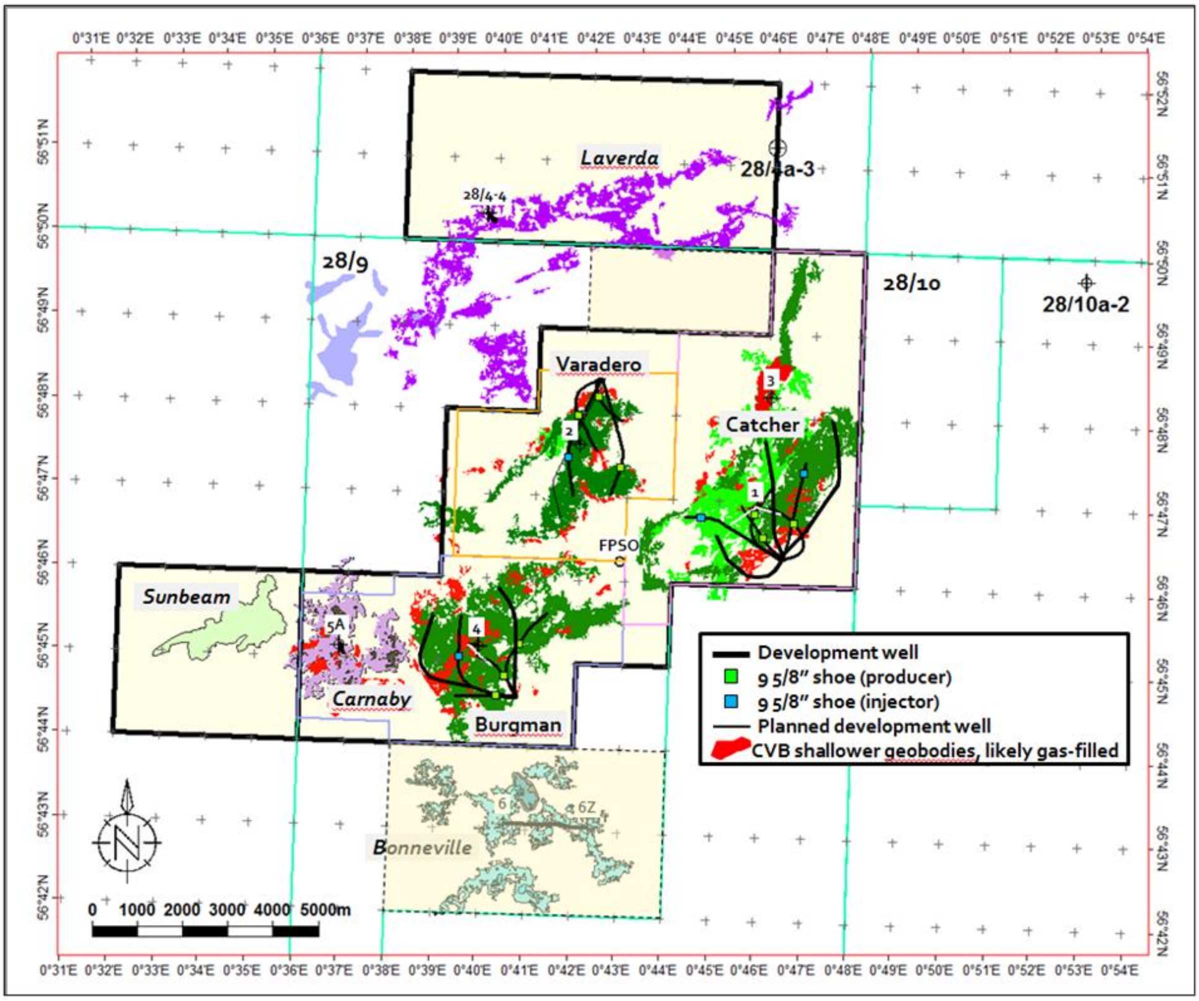



**Figure 2-1: Laverda Field Area Map.**

**Table 2-1: Reservoir Properties.**

| Property | Value |
|---|---|
| Reservoir type | Oil |
| Reserves | *c.* 2.8 mmbls* |
| Density at standard conditions (te/m$^3$) | 0.9187 |
| Oil gravity | 22.4°API ** |
| Solution Gas-Oil Ratio at Saturation Pressure | 190 scf/bbl of residual oil at 60 °F |
| Wax content | 1.2 % |
| *MMbls – million barrels<br>** American Petroleum Institute | |

## 2.3 Option Selection

### 2.3.1 Development Options

Though not within the formal scope of this ES, this section also considers the options considered for the development of the Catcher North Field, due to the early recognition that both the Laverda and Catcher North Fields could be drilled from the same surface location. The initial development options considered were:

- **Option 1**: Drilling of both wells (i.e. one Laverda well and one Catcher North well) from the same location with installation of minimum subsea facilities (selected Option).
- **Option 2**: Drilling of both wells from the same location with installation of additional subsea facilities.
- **Option 3**: Drilling of both wells at different locations.

A qualitative review was carried out during concept selection to determine the optimal option. In summary, a number of various features considered did not differ significantly between the three development options. However, Option 1 was selected as the preferred option as a result of the minimal subsea infrastructure requirements, safety concerns, environmental impacts (e.g. seabed footprint) and Capital Expenditure (CAPEX) associated with it (Table 2-2).

**Table 2-2: Laverda and Catcher North Development Options.**

| Considerations | Option 1 (selected option) | Option 2 | Option 3 |
|---|---|---|---|
| **Complexity of wells** | Long step out, however similar wells have been drilled as part of the wider Catcher Area Development; therefore, not considered a significant differentiator. | Long step out, however similar wells have been drilled as part of the wider Catcher Area Development; therefore, not considered a significant differentiator. | Shorter wells to drill, however a drilling rig move would be required. |
| **Complexity of subsea infrastructure** | Minimal subsea infrastructure, drilling template, one production and one gas lift flowline. Controls for both wells provided by a single EHC umbilical. | More facilities relative to Option 1 in that it would require an additional manifold at the drill centre location. | Two drill centres would require the installation of two production and gas lift flowlines and two EHC umbilicals. |
| **Safety** | Least complex facilities with minimal safety risks (e.g. no rig move required). | More complex facilities relative to Option 1 but still minimal safety risks. | This option would involve an extra rig move and the installation of two production flowlines, two gas lift flowlines and two EHC umbilicals. Application of industry standards means the risk of this option is considered low, however it is still higher than the risk associated with Options 1 and 2. |
| **Environmental** | Minimum facilities and therefore minimum environmental impact. | More facilities relative to Option 1, hence a greater environmental impact associated with seabed disturbance, emissions from installation vessels etc. | With two drill centres, the environmental impact associated with the installation of the subsea infrastructure is greater than those associated with Option 1 or 2. In addition increase in seabed disturbance associated with requirement for drilling rig move. |
| **Capital Expenditure (CAPEX)** *Note for confidentially reasons the estimated costs are not shared here. Rather the costs for each option are considered relative to the other options.* | Lowest cost. | Higher cost relative to Option 1. | Highest cost relative to Options 1 and 2. |

### 2.3.2 Tie-Back Options

With respect to the selected option to drill from a single drill centre with minimal subsea infrastructure, three tie-back options were considered as described in Table 2-3. Assessment of the three options resulted in Option C i.e. a tie-back to the existing Varadero drill centre manifold being selected.

**Table 2-3: Tie-Back Options.**

| Tie back options | Considerations |
|---|---|
| **Option A**<br>Tie-back directly to the BW Catcher FPSO | • A tie-back directly to the FPSO would entail the installation of at least three new flexible risers at the FPSO: one each for the production and gas lift flowlines and one for the EHC umbilical.<br>• Installation of these risers would require modifications to the FPSO topsides which would require shut-in of all production whilst the work is being carried out.<br>• A tie-back to the FPSO would require a manifold to be installed at the drill centre location (i.e. Option 2 above)<br>• The flowlines and EHC umbilical would be *c*. 5 km in length and therefore more than twice the length of those associated with Option C.<br>• Highest CAPEX of the three options. |
| **Option B**<br>Tie-back to the manifold at the Catcher drill centre | • The flowlines and EHC umbilical would be *c*. 5.4 km in length and therefore more than twice the length of those associated with Option C.<br>• All the slots have been taken on the Catcher manifold and therefore the tie in would have to be at the end of the manifold. This would not allow access to the subsea multiphase flow meter. Thus a manifold structure with multi-phase meter would have to be provided for this tie-back option. This would result in increased costs relative to Option C.<br>• A tie-back to the Catcher manifold would mean that eight production wells would flow into the existing flowline between the Catcher manifold and the FPSO. Relative to Option C this results in a greater potential for back out[3] from some wells due to potential restrictions associated with the flowline. Note for Option C, six production wells would flow into the existing flowline.<br>• Higher CAPEX relative to Option C. |
| **Option C**<br>Tie-back to the manifold at the Varadero drill centre<br>(selected option) | • Shortest (*c*. 2.4 km) flowlines and EHC umbilical associated with this option.<br>• Lower production levels are expected from the Varadero Field (four wells) relative to the Catcher Field (six wells) such that there would be less back out due to potential restrictions in the flowline.<br>• Uses existing subsea multi-phase flow meter thereby requiring no additional CAPEX.<br>• Lowest CAPEX relative to Options A and B. |

[3] Back-out is the preferential production from one field over another.

### 2.3.3 Flowline and EHC Umbilical Installation Options

In order to mitigate potential impacts from interaction with trawl gear, the selected solution was for the flexible flowlines (8" production and 3" gas lift) and EHC umbilical to be surface laid and protected from trawl gear impacts using rock cover along the main lengths. Mattresses will also provide additional protection at the exposed ends (approaches and tie-in points), located wholly within the 500 m zones.

Trench and burial of the flowlines and umbilical was not considered practicable as this option would result in unnecessary HSE and operational (SIMOPS) risks from potential collision impacts and accidental damage. The optimised schedule means that the trenching operation is required to occur simultaneously with the drilling operation. As a result, the close proximity of the trenching operations to:

1) the HDJU drill rig present at the CNDT location (for c. 150 days as it drills both the Laverda and Catcher North wells, in sequence); and

2) the existing hydrocarbon conveying Varadero Drill Centre infrastructure at the opposite end

has precluded its use.

Protecting the installed flowlines and the EHC umbilical under a single rock berm was not considered practicable, due to the excessive size (and large quantities of rock) required to achieve the required 1:3 berm profile. A combination of geotechnical, buckling and flow assurance studies have confirmed that the optimal protection solution is:

- Two rock berms separated by a maximum of 50 m (between berm centres). The final berm separation distance will be optimised during the project's detailed design stage;
- The main section of the gas lift flowline will be located 50 m north of the production flowline and covered with a rock berm to provide a minimum rock cover height of 0.5 m (from top of pipe);
- The main section of the 8" production flowline will be located 50 m to the south of the gas lift flowline; the umbilical will be located 3 m to the south of the production flexible. Both these products will be covered by a single berm, designed to ensure a minimum rock cover over each product of 0.5 m (from top of pipe).

The maximum 50 m distance between berms is in line with SFF preferences (see Table 1.3), however, the final distance between berms will be confirmed during Detailed Design.

## 2.4 Schedule of Activities

The activities associated with the drilling, installation, and commissioning of the Laverda Field Development are scheduled to take place in 2020, with First Oil in Q1 2021 as shown in Table 2-4. It should be noted that the schedule presented is indicative only and may change as the project develops.

**Table 2-4: Indicative Schedule of Activities.**

| Activity | 2020 | | | | 2021 |
|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 |
| Drilling of Laverda and Catcher North well | | | | | |
| Installations of subsea infrastructure | | | | | |
| Tie-ins and commissioning | | | | | |
| First oil | | | | | |

## 2.5 Drilling Activities

It is proposed to drill the wells at the CNDT with a Heavy Duty Jack Up (HDJU) drilling rig. The Laverda well is expected to take around 75 days to drill and as shown in Table 2-4. Drilling is anticipated to be carried out in Q2/Q3 2020.

The CNDT will be located at: 56° 48' 56.20" N and 00° 44' 08.56" E (WGS84).

### 2.5.1 Positioning of the HDJU

The HDJU drilling rig will likely be towed to the drilling location and positioned using two tugs and an Anchor Handling Vessel (AHV). An Emergency Response and Rescue Vessel (ERRV) will also be in attendance.

As required by the HSE Operations Notice 6, a rig warning communication will be issued at least 48 hours before any rig movement. The route will be selected in consultation with other users of the sea, with the aim of minimising interference to other vessels and the risk of collision. Prior to moving the rig on location, POUK will arrange for a vessel traffic survey to be carried out, the results of which will be used to implement a collision risk management plan. In addition, the collision risk assessment will be included in the Consent to Locate applications.


**Figure 2-2 Typical Jack-Up Rig Under Tow.**

Typical HDJU drilling rigs have three vertical legs fitted through openings on the outer hull. Positioning of the rig over the drilling template will require four anchors. These anchors and the associated anchor chains will be recovered once the rig is on location. Having been towed to the site, the HDJU drilling rig's legs will be jacked down onto the seabed, with the hull raised on its legs above the water providing a stable platform. Excessive penetration by the legs into soft seabed is prevented by large spud cans at the bottom of the legs. The spud cans typically have a diameter of approximately 18 m, and hence three spud cans will disturb approximately 764 $m^2$ ($\pi r^2 \times 3$) of seabed.

The depth of disturbance varies with sediment. It is anticipated that the seabed at the proposed CNDT location, will be disturbed to a depth of between 1 – 4 m directly below the rig. POUK will conduct a rig site survey after the contract has been awarded, which will further define these depths. As the legs are pulled out, they may leave scars and/or sediment mounds.

In areas of scouring, HJDU drilling rigs can be further stabilised by rock dumping onto the spud cans. Scouring can be caused by strong currents near to the seabed, due to tidal and/or storm surge currents, and additional measures are sometimes required to prevent scour and to ensure that the rig remains stable on the seabed. Experience to date at the Catcher Area Development, suggests that rock dumping will not be required for rig stabilisation as HDJU rigs have successfully drilled in the area without any reported scouring issues. A remotely operated vehicle (ROV) will be used to monitor for evidence of scour around the legs, once the rig is in place.

Details of the selected HDJU drilling rig and its positioning will be included in the subsequent drilling operation SAT applications, which will be submitted to BEIS via the UK Oil Portal.

### 2.5.2 Blowout Preventer

The HDJU drilling rig mobilised for the development will be fitted with a Blowout Preventer (BOP) stack which will be rated for the maximum pressure anticipated for the well being drilled. The function of the BOP is to prevent uncontrolled flow from the well by positively closing in the well, as and when required. The BOP is made up of a series of hydraulically operated rams, that can be closed in an emergency from the drill floor and also from a safe location elsewhere on the rig.

A surface BOP will be installed on to a high-pressure riser which will be connected to the subsea well head system.

The integrity of the BOP will be tested prior to usage and rated over the range of pressures predicted to occur within the well. Pressure testing of the BOP will be undertaken in line with the drilling contractor and POUK procedures, UK legislation and industry standards.

### 2.5.3 Well Design

The basic well profile for the Laverda well is summarised in Table 2-5 and illustrated in Figure 2-3. Detailed well design specifics are still under analysis, but will be provided in future drilling SAT permit applications.

**Table 2-5: Laverda Well Completion Details.**

| Hole section | Casing | Drilling fluid | Total vertical depth below seabed (ft) | Total length along hole (ft) |
|---|---|---|---|---|
| 36” | 30” conductor | Seawater with viscous sweeps | 227 | 227 |
| 26” | 20” surface casing | | 920 | 920 |
| 16” | $13^{3}/_{8}$” intermediate casing | LTOBM | 3,160 | 3,545 |
| $12^{1}/_{4}$” | $9^{5}/_{8}$” production casing | | 4,095 | 10,230 |
| $8^{1}/_{2}$” / $9^{1}/_{2}$” | n/a | | 4,137 | 13,728 |

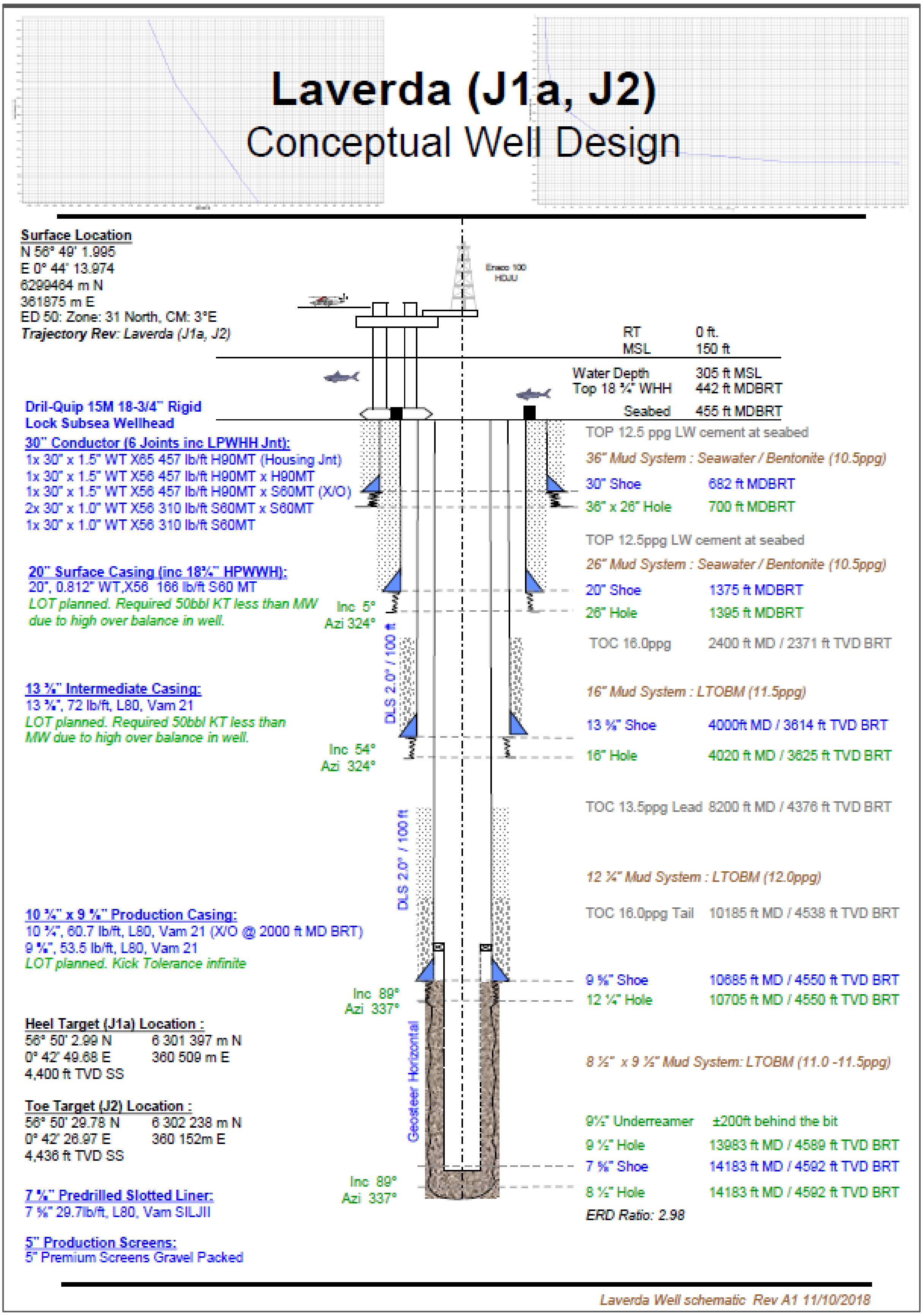



**Figure 2-3: Example Schematic of the Proposed Laverda Well.**

### 2.5.4 Drilling Mud and Cuttings

Drilling fluids are required for a number of reasons including:

- Managing hydrostatic pressure and primary well control;
- Transportation of the cuttings to the surface;
- Preservation of the wellbore to facilitate casing / completion installation; and
- Cooling and lubrication of the drill bit.

Drilling fluid is continuously pumped down the drill string to the drill bit and returns to the surface through the annular space between the drill string and the sides of the well. Different mud formulations are required at different stages in the drilling operation because of variations in pressure, temperature and the physical characteristics of the rock being drilled.

Table 2-6 summarises the anticipated mud volumes and mass of cuttings associated with each well section. The fate of the drill cuttings from each section is also shown. Full details of the mud volumes to be used will be provided in subsequent SAT applications to BEIS.

**Table 2-6: Anticipated Mud Requirements and Cuttings Mass Associated with the Well.**

| Hole size (") | Drilling fluid | Volume of mud ($m^3$) | Mass of cuttings (te) | Cuttings disposal route |
|---|---|---|---|---|
| 36” | Seawater with viscous sweeps | 57 | 150 | Discharged at the seabed |
| 26” | | 90 | 235 | |
| 16” | LTOBM | 120 | 310 | Skipped and shipped |
| $12^{1}/_{4}$” | | 120 | 443 | |
| $8^{1}/_{2}$” / $9^{1}/_{2}$” | | 54 | 140 | |

### 2.5.5 Cementing Chemicals

Cement is used to secure the steel conductor and casings in the well bore, whilst cementing chemicals are used to modify the technical properties of the cement slurry. During cementing operations, the majority of these chemicals are left downhole, but a small quantity of cement may be discharged onto the seabed around the top of the 30” and 20” conductors, while filling the annulus between the casing and the seabed with cement. This excess over the annulus volume, is required to give confidence that the cement has completely filled the conductor annulus and displaced all the mud present to provide a strong bond, on which the entire well is secured. Subsequent use of cement is contained downhole as lower casings do not require the cement to be pumped into the annulus all the way up to the surface.

Discharges of other cementing chemicals such as cement mix water and spacers may occur when cleaning out the cement mixing and pumping equipment. Cement mix water is the term used to describe the fluids used to mix the cement, whilst spacers are the fluids used to aid the removal of drilling fluids before cementing.

At the time of writing, the detailed cement design has yet to be finalised, however estimates are provided in Table 2-7.

**Table 2-7: Estimated Cement Requirements for the Well.**

| Cement job | Volume of cement (bbls) | Cement type |
|---|---|---|
| 30" conductor | 500 | Light Weight Thixotropic |
| 20" surface casing | 700 | |
| $13^{3}/_{8}$" intermediate casing | 150 | Class G |
| $9^{5}/_{8}$" production casing | 200 | |
| *Rapid Hardening Cement | | |

All cementing chemicals to be used will be selected based on their technical specifications and environmental performance. Light Weight Thixotropic and Class G cements have no additions, other than calcium sulphate and/or water and are intended for use as a basic well cement. Chemicals with substitution warnings (i.e. chemicals that are considered to be harmful to the environment) will be avoided, where technically possible. The cementing chemicals to be used have not yet been determined, but will be detailed in subsequent drilling SAT permit applications.

Similar to the drilling and cementing chemicals, the chemicals associated with the completions operations will be captured in the subsequent drilling SAT permit applications.

### 2.5.6 Relief Well Location

A relief well plan will be put in place to intersect the Laverda well in the event of a blowout and will include a proposed rig location from which a relief well could be drilled.

### 2.5.7 Drill Rig Support Activity

Various support vessels will be associated with the drilling operations such as AHVs, supply vessels etc. Table 2-8 summarises the estimated duration that each vessel will be on site, and their estimated fuel use. Estimates provided are based on an indicative maximum drilling duration of 75 days for the well.

Three helicopter trips per week are assumed, with a round trip of 3 hours from an Aberdeen based heliport.

**Table 2-8: Fuel Consumption of Vessels Associated with the Drilling of the Laverda Well.**

| Vessel type | Days on site[1] | Fuel consumption (te/d)[2] | Total fuel use (te) |
|---|---|---|---|
| HDJU drilling rig | 75 | 7.2 | 540 |
| Two tugs and an AHV (rig transit) | 9 (assumes three days for rig mobilisation (therefore 3 x 3) | 25 | 225 |
| Two tugs and an AHV (rig positioning) | 12 (assumes four days for rig mobilisation (therefore 3 x 4) | 25 | 300 |
| Emergency Response and Rescue Vessel (ERRV) | 75 | 1.5 | 112.5 |
| Supply vessel (in transit) | 38 | 10 | 380 |
| Supply vessel (working) | 38 | 1.5 | 57 |
| Helicopter (te/hr) | Three per week (32 trips – 3 hours each) = 96 hours | 0.5 per hour | 48 |
| **Total fuel use** | | | **1,662.5** |

[1] Drilling schedule still being developed, duration presented is the maximum anticipated for drilling of the Laverda well.
[2] Source: The Institute of Petroleum, 2000.

## 2.6 Subsea Infrastructure

Figure 1-3 shows the infrastructure to be installed as part of the proposed Laverda and Catcher North Field Developments, in relation to the existing infrastructure at the Catcher Area Development. Table 2-9 provides summary details on the infrastructure.

**Table 2-9: Subsea Infrastructure Associated with the Proposed Laverda and Catcher North Developments.**

| Structure | Description |
|---|---|
| CNDT | The CNDT (13.85 m (L) x 12.25 m (W) x 9.66 m (H)) will be a four slot piled drilling template. One of the slots will house the subsea production and gas lift pipework, and EHC control systems whilst the Catcher North and Laverda wells will occupy two of the other slots. One spare slot will remain for potential future use.<br>As mentioned previously, the installation of the CNDT has been permitted through the SAT permit applications associated with MAT DRA/616, such that the activities and subsequent environmental impacts associated with its installation are not considered further here. This approach was agreed with BEIS (meeting 5/10/18). It is listed on this table for completion. |
| Production flowline | A *c*. 2.4 km x 8” production flowline will be installed on the seabed and protected with rock (detailed below). |
| Gas lift flowline | A *c*. 2.4 km x 3” gas lift flowline will be installed on the seabed and protected with rock (detailed below). |
| EHC umbilical | A *c*. 2.4 km EHC umbilical will be installed on the seabed and protected with rock (detailed below). |
| Spools and EHC jumpers | At the approaches to the CNDT and the existing Varadero manifold, the production and gas lift spools and EHC jumpers will also be surface laid to allow their tie-in. At each approach, the respective lengths which vary between 10 m and 40 m will be covered by concrete mattresses. |
| Well | Laverda well and associated Xmas tree etc. |
| Rock cover | The flowlines and EHC umbilical will be surface laid and rock covered. Two rock berms will be required. One rock berm (*c*. 20,500 te) will be used to protect the production flowline and EHC umbilical and a second rock berm (11,500 te) will be required to protect the gas lift flowline. These rock berms will be laid around 50 m apart. As mentioned previously (see Section 2.3.3) the final separation distance will be optimised during Detailed Design. As a contingency the ES assumes 25,500 te of rock on the larger rock berm and 14,500 te on the smaller berm. |
| Mattresses | At the approaches to both the CNDT and the Varadero manifold, the production and gas lift spools and the EHC jumpers will be installed with a 3 m separation to minimise the number of mattresses required for protection. Around 75 mattresses will be required at the CNDT and up to 140 mattresses will be required at the approach to the Varadero manifold (note these estimates allow for a 12-15% contingency). |
| Grout Bags | Up to 2,000 x 25 kg grout bags (hessian sacks) will be laid in the same area as the mattresses: 650 grout bags at CNDT and 1,350 grout bags at the Varadero manifold. |

### 2.6.1 Wellhead and Xmas Tree

The Xmas tree at the Laverda well will be of similar design to those used at the Catcher, Varadero and Burgman Fields.

The vertical Xmas tree will have an arrangement of hydraulically operated valves, with manual back-up valves, to provide integrity barriers from the reservoir. The trees will also feature a Downhole Safety Valve (DHSV) which is a hydraulically operated isolation device.

Scale inhibitor will be injected topsides which will require the provision of injection metering and control valve, whilst wax inhibitor will be injected subsea at the production well.

Methanol will be injected on an intermittent basis, primarily for the inhibition of hydrates during transient operations. Methanol use will be metered at the BW Catcher FPSO.

A meter to monitor lift gas volumes will be located on the production well.

### 2.6.2 Flowlines and EHC Umbilical and Associated Rock Cover

Table 2-9 summarises the lengths and sizes of the flowlines and EHC umbilical associated with the proposed Laverda and Catcher North Developments. During concept select, it was determined that surface laying the lines and protecting with rock cover was the optimal selection (see Section 2.3.3). The production flowline and EHC umbilical will be laid *c*. 3 m apart and protected with a single rock berm, whilst a second rock berm will protect the gas lift flowline. The rock berms will be *c*. 50 m apart in line with SFF preference.

Rock will be placed along the flowlines using the fall pipe method. The fall pipe extends from the work vessel to a position just above the seabed where the material is to be placed (Figure 2-4). This targeted placement of rock on the seabed is a common solution for the protection of offshore flowlines, umbilicals cables etc and for scour protection in the oil and gas and windfarm industries.

Estimated quantities of rock for each berm are provided in Table 2-9. Across the two berms, it is estimated that *c*. 32,000 te of rock will be required, though as a contingency this ES allows for any additional 25 % i.e. assumes 40,000 te in total. Figure 2-5 illustrates the expected berm profiles. The larger rock berm protecting the production flowline and EHC umbilical, is anticipated to impact on a corridor width of 8.03 m, whilst the smaller rock berm protecting the gad lift flowline is anticipated to impact on a corridor width of 4.76 m. The rock will comprise 1-5” rock pieces, and the gradient of the berm will have a 1:3 profile.

Prior to installing the flowlines, EHC umbilical and rock cover POUK will submit a Pipeline Works Authorisation (PWA) and Deposit Consent application to OGA, in addition to supporting EIA Directions to BEIS.

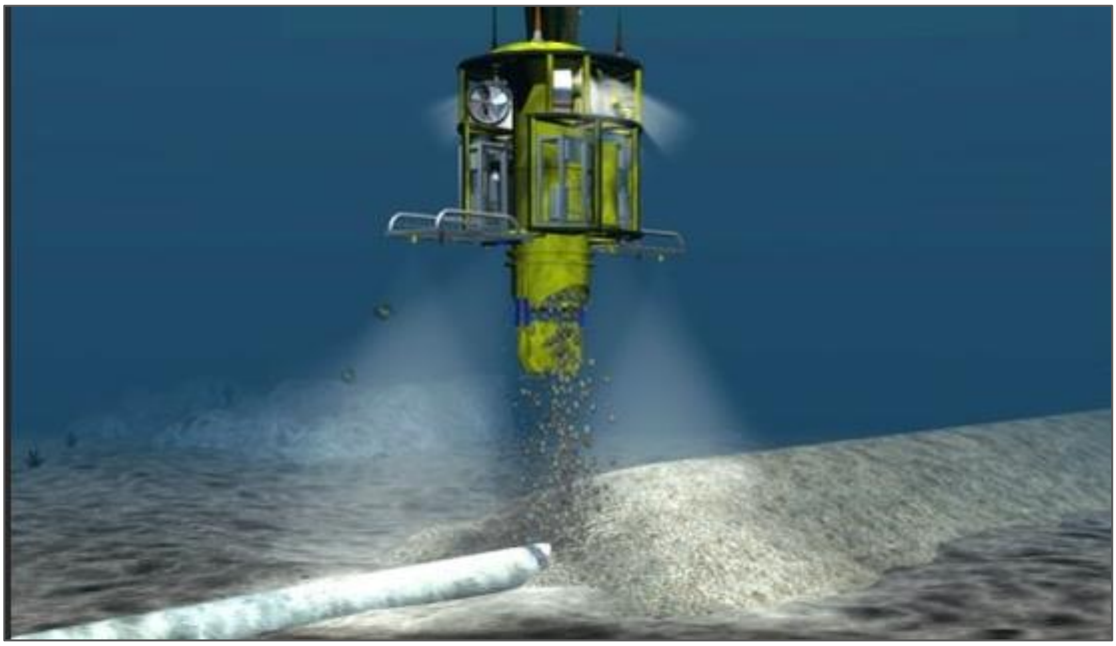


**Figure 2-4: Illustration Showing Rock Being Placed Using a Fall Pipe.**

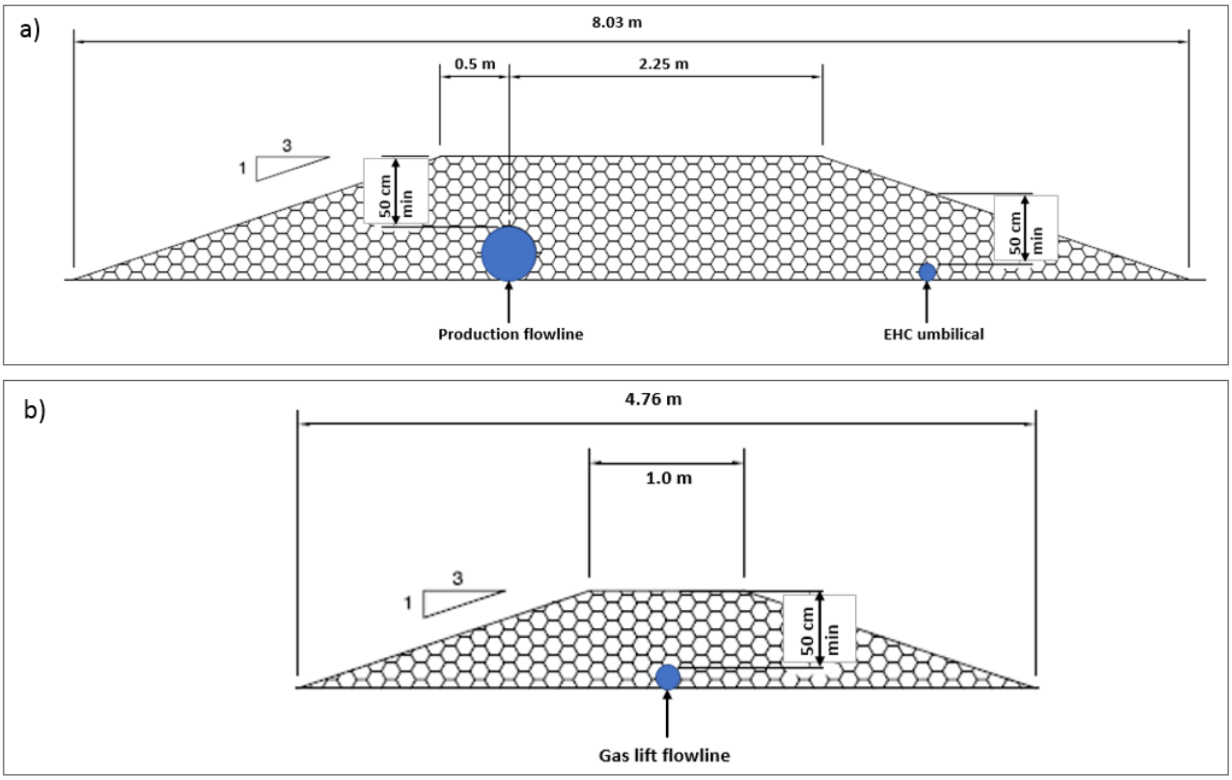



**Figure 2-5: Schematics Showing (a) Rock Berm Profile over the Production Flowline and EHC Umbilical and (b) Rock Berm Profile over the Gas Lift flowline.**

### 2.6.3 Spools, EHC Umbilicals and Associated Mattresses

Spools and EHC jumpers will be used to tie the flowlines and EHC umbilicals to the CNDT and the Varadero manifold. These structures will be surface laid, within the 500 m exclusion zones and protected using mattresses (6 m (L) x 3 m (W) x 1.5 m (H) and 25 kg grout bags. It is estimated that around 75 mattresses will be required at the CNDT location, whilst 140 mattresses are expected to be used at approaches to the Varadero manifold (Note: these estimates include a 12 – 15 % contingency). The 25 kg grout bags (hessian sacks) will be used to support the spools at the tie-in points to the CNDT (estimated at 650 grout bags) and Varadero manifold (estimated at 1,350 grout bags) and will be laid in same area as the mattresses to provide protection to the spools and EHC umbilicals.

Prior to installing any spools, EHC jumpers, mattresses or grout bags, POUK will submit a PWA and Deposit Consent application to the OGA, in addition to supporting EIA Directions to BEIS.

### 2.6.4 Pipeline Testing and Commissioning

Following installation, testing operations will be performed to ensure the production and gas lift systems' integrity, to test for any leaks, to dewater the gas lift flowline system and to prepare the systems for the introduction of hydrocarbons.

Once the complete flowline systems have been connected, a hydrostatic pressure test (leak test) will be carried out, to prove the integrity of the tie-in connection points. The pipelines will be pressurised in accordance with design codes, to pressures above the maximum operating pressure. On completion of the testing programme, the pressurisation fluid is expected to be discharged to sea.

The gas lift flowline between the header pipework at the CNDT and the Varadero manifold will be dewatered, and the flowline contents discharged to sea. The mix (comprising water, MEG and tracer dye) will have been previously injected into the flowline onshore at the fabricators yard. Dewatering of the flexible between the Varadero manifold and the CNDT, will be performed using nitrogen gas as the propelling medium, and a foam pig being introduced as a mechanical interface, to remove as much of the water/MEG/tracer dye mix as possible. The flowline will be left filled with nitrogen gas at the completion of the operation.

The permitted discharge of chemicals to the marine environment is a routine part of subsea installation operations. The quantities of chemicals to be used and whether or not they are to be discharged, will be determined during the project detailed design stage and will be subject to a permit under the OCR. As the chemical regime will be subject to a separate permit (a chemical SAT), there is no foreseen benefit gained from replicating a risk assessment at this stage as a risk assessment will be carried out as per the OCR with known chemicals, profiles and associated application. Based on current methodologies, there are no chemicals planned for use/discharge that significantly differ from those currently on associated Catcher Area permits, that would imply that a specific chemical risk assessment requires to be carried out, as part of this ES.

### 2.6.5 Subsea Installation Support Vessels

Various support vessels will be associated with the subsea installation of the proposed Developments infrastructure. Vessel type, duration and fuel usage by vessels during installation are given in Table 2-10. A standby vessel (ERRV) has not been accounted for, as the pipeline installation activities are scheduled to be carried out whilst the Laverda and North Catcher wells are being drilled. Therefore, the ERRV vessel associated with the HDJU drilling rig will also support the installation vessels.

**Table 2-10: Anticipated Vessel Type, Duration and Fuel Usage During Subsea Infrastructure Installation.**

| Vessel type | Duration (days) | Working fuel consumption (te/d)* | Total fuel use (te) |
|---|---|---|---|
| Pipelay vessel | 15 | 23 | 345 |
| Dive support vessels (DSV) | 21 | 18 | 378 |
| Rock cover vessel | 8 | 15 | 120 |
| *The institute of Petroleum 2000. | | | |

## 2.7 BW Catcher FPSO Overview

The proposed concept for the Laverda Field Development means that the gas and liquids can be processed within the existing capacity of the BW Catcher FPSO, without modifications to processing facilities. As a result, only a brief overview of the BW Catcher FPSO is provided here. The BW Catcher FPSO arrived on station in October 2017 and production commenced in December 2017. The FPSO's mooring system comprises three clusters of four mooring lines i.e. 12 mooring lines in total. Details of the BW Catcher FPSO, including storage capacity, are provided in Table 2-11.

**Table 2-11: Details of the BW Catcher FPSO.**

<table>
<tr><th colspan="2">Description</th><th>Value</th></tr>
<tr><td colspan="2">Length</td><td>241 m</td></tr>
<tr><td colspan="2">Breadth</td><td>50 m</td></tr>
<tr><td colspan="2">Accommodation</td><td>112 personnel</td></tr>
<tr><td colspan="2">Crude storage</td><td>650,000 bbl</td></tr>
<tr><td rowspan="6">Production system capabilities</td><td>Oil production</td><td>60,000 bbls/day</td></tr>
<tr><td>Gas handling</td><td>60 MMscf/day</td></tr>
<tr><td>Produced water handling</td><td>125,000 bbls/day</td></tr>
<tr><td>Total liquids handling</td><td>125,000 bbls/day</td></tr>
<tr><td>Total water injection</td><td>125,000 bbls/day</td></tr>
<tr><td>Sea water injection</td><td>75,000 bbls/day</td></tr>
</table>

Existing facilities on the BW Catcher FPSO include: separation and oil processing, gas compression and dehydration, water processing and injection. The utility systems include chemical injection, instrument air supply, fuel gas, flare and oil storage facilities.

With a maximum oil production rate of approximately 60,000 bbls/d (9,540 $m^3$/d) and 650,000 bbl (103,350 $m^3$) total crude storage capacity, offloading takes place approximately every 10 days.

The power requirements of the BW Catcher FPSO are supplied by three Solar Titan 130 gas turbine generators primarily run on fuel gas. The generators can also run on diesel, supplied by the installation diesel system for the periods when fuel gas is not available.

## 2.8 Production

Chemicals are used during the production of hydrocarbons to maintain process efficiency, for example: demulsifiers improve the separation of oil and water; scale inhibitors slow down the build-up of scale in pipework and valves and biocides reduce microbial growth.

Chemical usage and discharge will be captured in an update to the BW Catcher FPSO production permit, prior to production commencing. Anticipated chemical requirements associated with the production of hydrocarbons from the Laverda Field, are not expected to differ to those associated with the current BW Catcher FPSO chemical permit which covers FPSO production operations and chemical injection at the subsea Xmas trees. As a result, a specific chemical risk assessment has not been performed as part of this ES.

Production profiles have been developed for the Laverda Field Development. These profiles forecast the high case, volumes of oil, gas and PW that could be produced. However, it should be noted that these volumes will be limited by the available FPSO processing capacity. Note the combined production profiles presented for the Catcher, Varadero and Burgman Fields are the latest profiles applied for in the facilities Production Consent (PRA/213) for 2019 onwards.

### 2.8.1 High Case Oil Production Profiles

Table 2-12 and Figure 2-6 show the anticipated high case oil production rates from the Laverda Field and the Catcher, Burgman and Varadero Fields (combined) assuming start-up in 2021. As described previously, Laverda production will be used to fill FPSO ullage and reduce the rate of decline in the production profile. The highest annual oil production rate from the Laverda Field is anticipated in the first year of production. As can be seen from Table 2-12, by the time that the Laverda Field comes on line in 2021, the oil production rates at the BW Catcher FPSO from the other Catcher Area Fields will have already reduced from their highest rates in 2019.

The profiles presented allow for operational flexibility via the preferential production from one field over another should it be required e.g. in the event that production from one field is cut back, the FPSO production capacity can be maintained by increasing production from other fields.

**Table 2-12: High Case Oil Production Rate.**

| Year | Laverda | Catcher, Varadero & Burgman | All fields | Laverda | Catcher, Varadero & Burgman | All fields |
|---|---|---|---|---|---|---|
| | te/day | | | $m^3$/day | | |
| **2018** | - | 9,323 | 9,323 | - | 10,412 | 10,412 |
| **2019** | - | 11,174 | 11,174 | - | 12,479 | 12,479 |
| **2020** | - | 10,596 | 10,596 | - | 11,833 | 11,833 |
| **2021** | 600 | 8,175 | 8,775 | 670 | 9,130 | 9,800 |
| **2022** | 488 | 5,666 | 6,155 | 545 | 6,328 | 6,874 |
| **2023** | 306 | 4,034 | 4,340 | 342 | 4,505 | 4,847 |
| **2024** | 211 | 3,036 | 3,247 | 236 | 3,391 | 3,627 |
| **2025** | 163 | 2,499 | 2,662 | 182 | 2,790 | 2,973 |
| **2026** | 135 | 2,149 | 2,283 | 150 | 2,400 | 2,550 |
| **2027** | 118 | 1,896 | 2,014 | 132 | 2,118 | 2,249 |
| **2028** | 108 | 1,668 | 1,776 | 121 | 1,863 | 1,984 |
| **2029** | 97 | 1,509 | 1,606 | 108 | 1,685 | 1,793 |
| **2030** | - | 1,368 | 1,368 | - | 1,528 | 1,528 |
| **2031** | - | 1,151 | 1,151 | - | 1,286 | 1,286 |
| **2032** | - | 1,063 | 1,063 | - | 1,187 | 1,187 |
| **2033** | - | 992 | 992 | - | 1,108 | 1,108 |

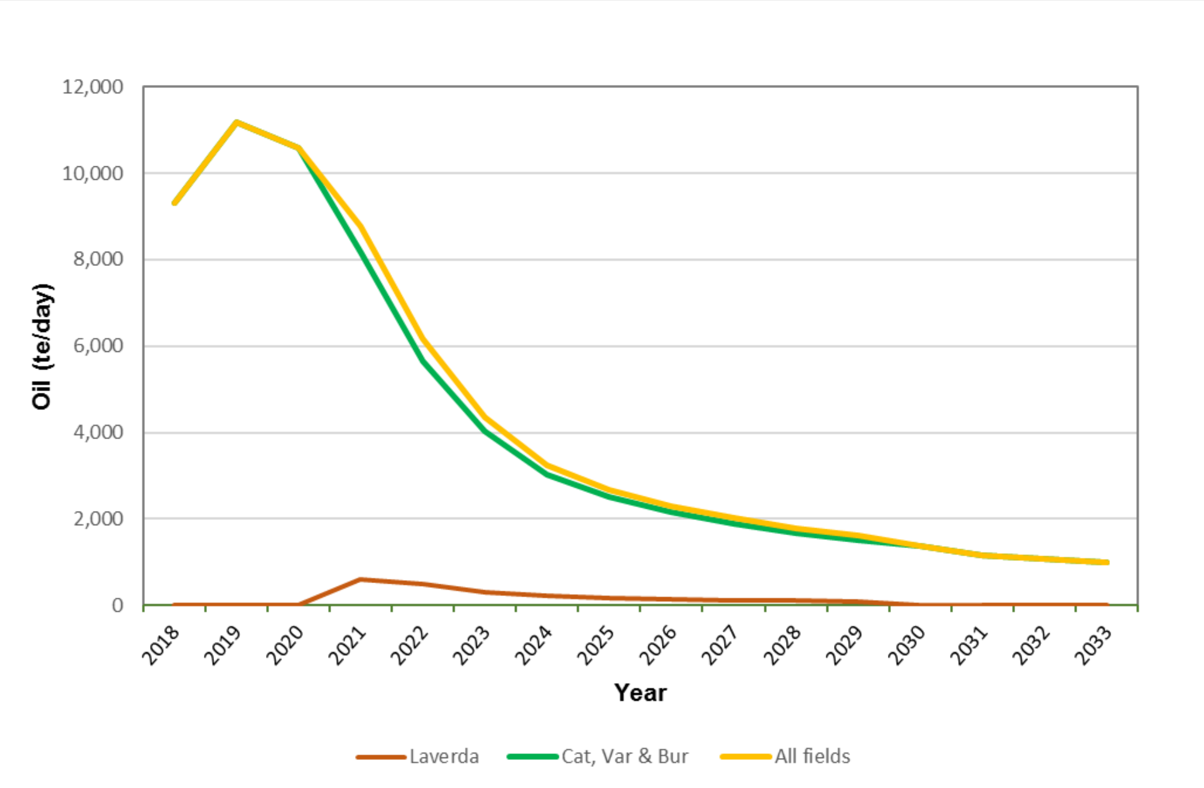



**Figure 2-6: High Case Oil Production Rate.**

### 2.8.2 High Case Gas Production Profiles

Table 2-13 and Figure 2-7 show the anticipated high case gas production rates from the Laverda Field, and the Catcher, Burgman and Varadero Fields (combined) assuming start-up in 2021. As described previously, Laverda production will be used to fill FPSO ullage and reduce the rate of decline in the production profile. The highest annual gas production from Laverda (and Catcher North) is anticipated in the first year of production. As can be seen from Table 2-13, by the time that the Laverda Field comes on line in 2021, the gas production rates at the BW Catcher FPSO will have already reduced from their highest rates in 2019.

**Table 2-13: High Case Gas Production Rate.**

| Year | Laverda | Catcher, Varadero & Burgman | All fields |
|---|---|---|---|
| | Mm$^3$/day | | |
| **2018** | - | 774 | 774 |
| **2019** | - | 1,446 | 1,446 |
| **2020** | - | 1,431 | 1,431 |
| **2021** | 39 | 1,000 | 1,039 |
| **2022** | 21 | 489 | 510 |
| **2023** | 13 | 341 | 354 |
| **2024** | 9 | 264 | 273 |
| **2025** | 6 | 224 | 231 |
| **2026** | 5 | 201 | 206 |
| **2027** | 4 | 171 | 175 |
| **2028** | 4 | 152 | 155 |
| **2029** | 3 | 136 | 139 |
| **2030** | - | 124 | 124 |
| **2031** | - | 58 | 58 |
| **2032** | - | 54 | 54 |
| **2033** | - | 50 | 50 |

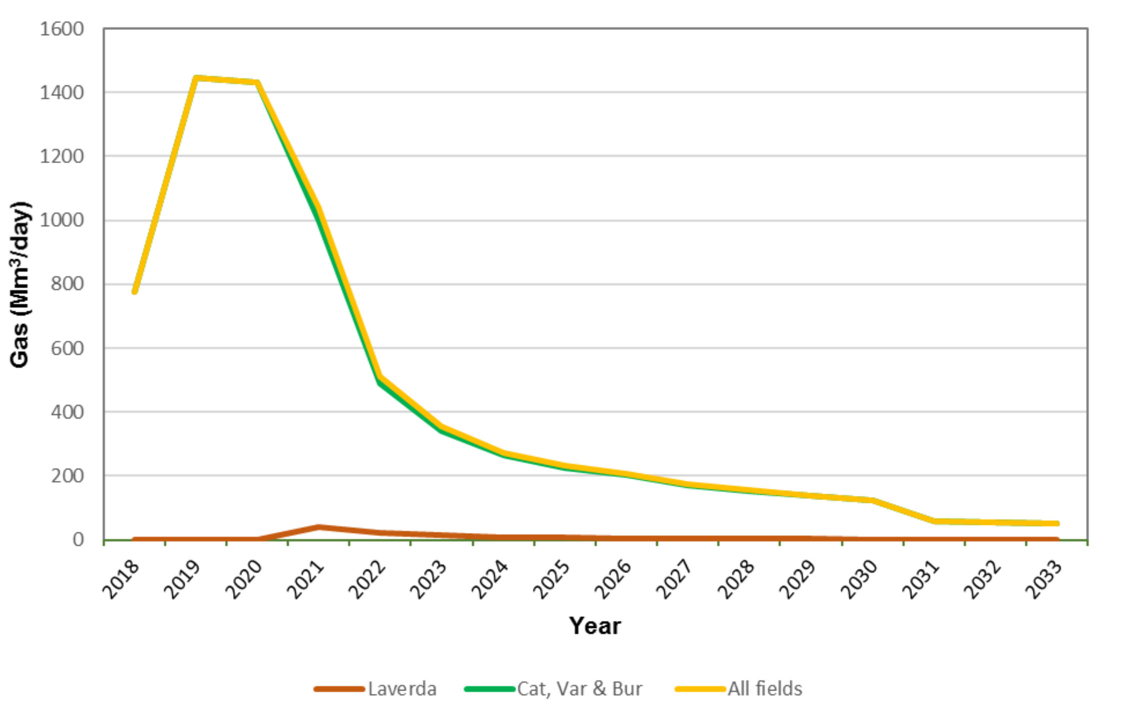



**Figure 2-7: High Case Gas Production Rate.**

### 2.8.3 High Case Water Production Profiles

Table 2-14 and Figure 2-8 show the anticipated maximum water production rates from the Laverda Field, and the Catcher, Burgman and Varadero Fields (combined) assuming start-up in 2021. The values presented took account of the water production rates associated with the P90, P50 and P10 production profiles and the maximum rate has been presented for each year. Maximum PW rates associated with the Laverda Field are anticipated in 2028 at a rate of 628 te/day.

When combined, the incremental PW produced water rates from Laverda will result in slightly higher potential produced water volumes to be generated. However, the actual volumes generated will not exceed the FPSO's PW handling capacity.

**Table 2-14: High Case Water Production Rate.**

| Year | Laverda | Catcher, Varadero & Burgman | All fields | Laverda | Catcher, Varadero & Burgman | All fields |
|---|---|---|---|---|---|---|
| | te/day | | | $m^3$/day | | |
| **2018** | - | - | - | - | - | - |
| **2019** | - | 6,169 | 6,169 | - | 5841 | 5,841 |
| **2020** | - | 19,408 | 19,408 | - | 18377 | 18,377 |
| **2021** | 369 | 22,029 | 22,398 | 350 | 20858 | 21,208 |
| **2022** | 475 | 22,997 | 23,472 | 450 | 21775 | 22,225 |
| **2023** | 529 | 24,090 | 24,619 | 501 | 22810 | 23,311 |
| **2024** | 507 | 24,379 | 24,886 | 480 | 23084 | 23,564 |
| **2025** | 562 | 25,047 | 25,609 | 532 | 23716 | 24,248 |
| **2026** | 597 | 25,238 | 25,835 | 565 | 23897 | 24,462 |
| **2027** | 617 | 25,837 | 26,454 | 584 | 24464 | 25,048 |
| **2028** | 628 | 25,837 | 26,465 | 595 | 24464 | 25,059 |
| **2029** | 604 | 25,837 | 26,441 | 572 | 24464 | 25,036 |
| **2030** | - | 25,837 | 25,837 | - | 24464 | 24,464 |
| **2031** | - | 25,837 | 25,837 | - | 24464 | 24,464 |
| **2032** | - | 25,837 | 25,837 | - | 24464 | 24,464 |
| **2033** | - | 25,837 | 25,837 | - | 24464 | 24,464 |

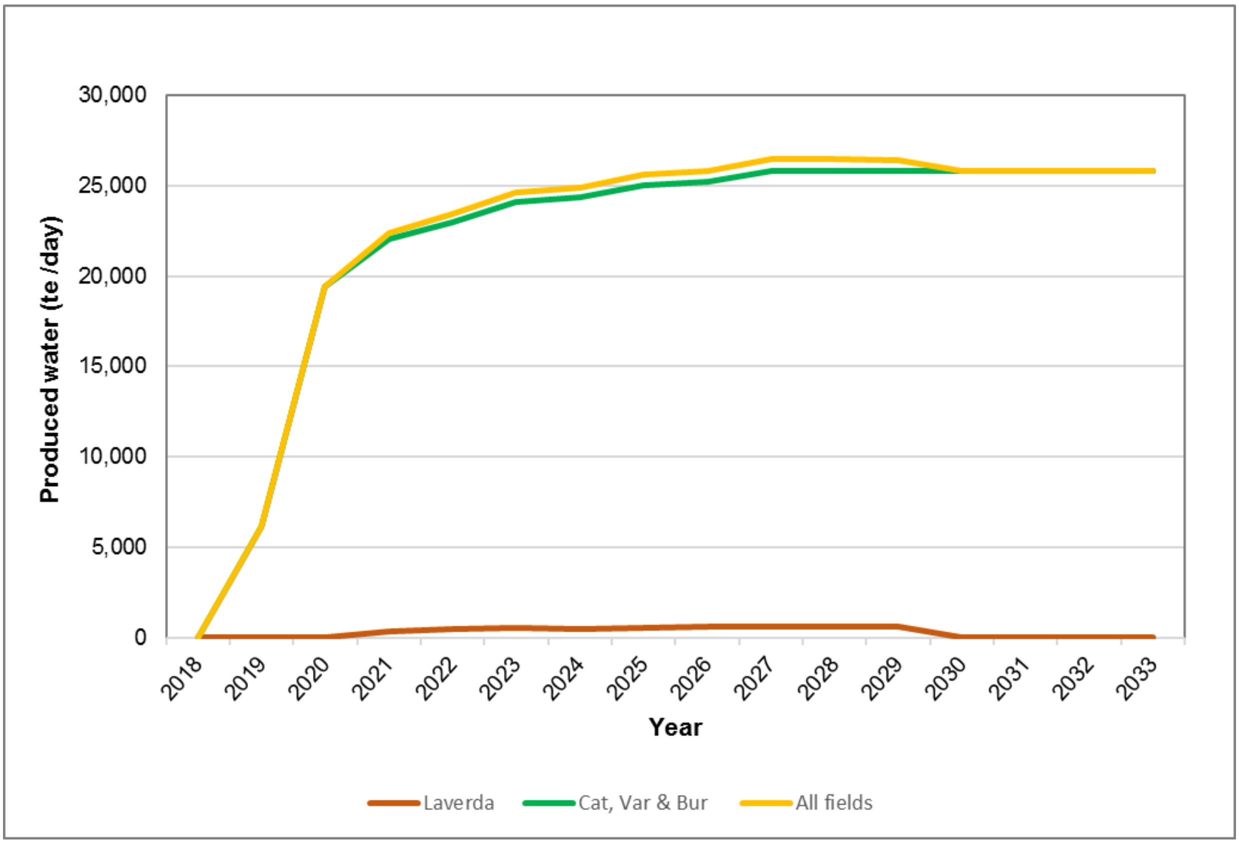



**Figure 2-8: High Case Water Production Rate.**

## 2.9 Key Permits and Consents

The Portal Environmental Tracking System ('PETS') is BEIS's environmental permitting system accessed via the UK Energy Portal. PETS integrates permits and consents under one centralised Master Application Template (MAT). There are six types of MAT available on the PETs system:

- Drilling Operations;
- Pipeline Operations;
- Production Operations;
- Decommissioning Operations;
- Well Intervention Operations; and
- A Standalone application.

Once a MAT has been created it can support various types of Subsidiary Application Templates (SATs). The following types of SATs are available:

- EIA Direction;
- Chemical Permit;
- Consent to Locate;
- Oil Discharge Permit (OPPC);
- Offshore Combustion Installations Permit (PPC);
- Marine Licence, EPS Disturbance Licence; and
- Marine Survey.

Note that OPEPs and EU ETS Permits are not available on the PETS system.

### 2.9.1 Pollution Prevention and Control (PPC) Permit

It should be noted that Laverda requires no changes to power generation equipment on the BW Catcher FPSO. However, the existing PPC permit will be reviewed and any changes to fuel use as a result of the Laverda tieback will be captured in a variation.

### 2.9.2 EU Emissions Trading Scheme (EU ETS)

No new Greenhouse Gas (GHG) Permit under the EU ETS Trading Scheme will be required; however, the description of the installation in the existing BW Catcher FPSO permit application will be updated to reflect Laverda coming online.

### 2.9.3 Oil Pollution, Prevention and Control (OPPC)

Discharges of oil to sea are controlled under The Petroleum Activities (Oil Pollution, Prevention and Control) Regulations 2005. The existing BW Catcher FPSO Oil Discharge Life Permit will be updated to capture Laverda coming on line. In addition, an Oil Discharge Term Permit will be issued for the drilling activities.

### 2.9.4 Chemical Use and Discharges to Sea

The relevant permits to use and discharge chemicals offshore will be applied for in accordance with the Offshore Chemicals Regulations (OCR). All offshore activities are covered by the Regulations including oil and gas production, drilling of wells, discharges from pipelines and discharges made during decommissioning.

### 2.9.5 Oil Pollution Emergency Plan (OPEP)

POUK will submit a Temporary Operations OPEP (TOOPEP) or consolidate into the existing OPEP for the drilling of the proposed Laverda well. The BW Catcher FPSO OPEP will be updated to incorporate production from Laverda.

### 2.9.6 Consent to Drill

POUK will submit a PON4 for consent to carry out drilling at the proposed project.

### 2.9.7 Consent to Carry out Surveys and Shallow Drilling

If required, POUK will submit Marine Survey SATs to BEIS describing any surveys associated with the proposed project. In addition, POUK will submit a Survey Closeout Report following any survey. A report detailing marine mammals sighted during the surveys using standard forms from the Joint Nature Conservation Committee (JNCC), will also be submitted.

### 2.9.8 Consent to Locate

Where applicable POUK will apply for the following Consent to Locates (CtL):

- Mobile Installation, e.g. mobile drilling units (MODUs);
- Permanent / Fixed Structure, e.g. Xmas trees;
- Pipeline or Cable System, e.g. gas and liquid flowlines, and control umbilicals; and
- Other Operation, e.g. Installation of surface buoys and moorings.

### 2.9.9 Pipeline Works Authorisation (PWA) and Deposit Consent (DepCon)

POUK will submit an application for a PWA detailing the flowlines, EHC umbilical etc to be installed whilst an application for a DepCon will be submitted providing the location of any rockdump, grout-bags and mattresses required on the route.

## 2.10 Decommissioning

At Cessation of Production (CoP), the Laverda infrastructure will be decommissioned in line with legislation in force at that time. In 2018 this would constitute the following:

- The Petroleum Act 1998 (as amended) and other relevant Regulations at the time of decommissioning;
- BEIS Decommissioning Guidance (Draft guidance, December 2017);
- The UK Guidelines for Suspension and Abandonment of Wells;
- The Pipeline Safety Regulations 1996 requiring the safe decommissioning of pipelines;
- Any additional applicable legislation in place at the time of decommissioning; and
- Any other agreements with the BEIS and relevant regulatory bodies.

### 2.10.1 Flowlines and Subsea Infrastructure

It is expected that the CNDT, spools, EHC jumpers, grout bags and mattresses will be removed from the seabed and returned to shore for reuse / recycling / disposal. In line with current guidelines and legislation, the decommissioning of the flowlines and EHC umbilical would be subject to a Comparative Assessment and Decommissioning Programme. It is expected the rock berm would be decommissioned in situ, however, this will be subject to legislation in place at the time.

### 2.10.2 Well

The Laverda well programme will be subject to a well notification, assessed by the Health and Safety Executive (HSE) under the Offshore Installations (Offshore Safety Directive) (Safety Case etc). Wells will be plugged and permanently abandoned in accordance with the OGUK Guidelines for the Abandonment of wells (OGUK, 2015) (or applicable guidance at that time). The well programme will have been reviewed by the HSE Offshore Safety Department as required under the Design and Construction Regulations.

On completion of the well abandonment programme, the conductor and internal tubing will to be cut below the seabed and the wellhead will be recovered.

Nearer the time of CoP, a full decommissioning plan will be developed in consultation with the relevant statutory authorities. The plan will be designed to ensure that potential effects on the environment resulting from the decommissioning of the facilities are considered and minimised. It is anticipated that Laverda will form part of a future Decommissioning Programme along with the wider Catcher Area Development.

# 3 ENVIRONMENTAL BASELINE

The well and infrastructure associated with the proposed Laverda Field Development, will be located in Block 28/9. This section provides a review of the baseline environment and principal environmental receptors, within the area. The environmental receptors considered include benthos, birds, fish, marine mammals and other sea users. This information is gathered from recognised literature sources and specific site surveys.

## 3.1 Environmental Baseline Surveys

POUK has previously commissioned a Survey Gap Analysis to be carried out, which reviewed of all the survey data collected across the Catcher Area Development (POUK, 2018). It was the conclusion of the report, that sufficient baseline information was available to support the proposed Laverda and Catcher North Developments. The report was shared with BEIS and their consultees, all of whom were in agreement with the findings. Table 3-1 and Figure 3-1 identify the survey reports, and the location of the surveys considered in the gap analysis. Figure 3-2 and Figure 3-3 show the location of seabed imagery and grab samples taken during the surveys. Where relevant, this section is supported with information from the Survey Gap Analysis report.

It should be noted that across the surveyed areas, the seabed type and benthic communities were generally uniform.

**Table 3-1 Environmental Surveys Carried Out in the Vicinity of the Laverda Field Development.**

| Map Reference | Surveys and Reports | Reference |
|---|---|---|
| | **Site Surveys** | |
| Ref 1 | Catcher Infield Environmental Habitat Assessment Report | Calesurvey 2012a |
| Ref 2 | Catcher North Well Site Survey. Geophysical Results Report. | Calegeo, 2010a |
| Ref 3 | Catcher Rig Site and Habitat Assessment Survey | Gardline, 2008 |
| Ref 4 | Laverda Site Survey | Gardline, 2016 |
| Ref 5 | Varadero Habitat Assessment Results Report. | Calegeo, 2010b |
| Ref 7 | Rapide and Cougar Well Site Survey. Habitat Investigation Results. | Fugro 2012 |
| Ref 8 | Burgman Site: Habitat Assessment Survey. | Calesurvey, 2012b |
| Ref 9 | Carnaby Primary Location Site Survey: Habitat Assessment Report. | Calesurvey, 2012c |
| Ref 10 | Bonneville Site Survey: Habitat Assessment Report. | Calesurvey, 2012d |
| Ref 11 | Coaster Site Survey: Habitat Assessment Report. | Calesurvey, 2012e |
| Ref 15 | North, South, East and West Infill Surveys. | Calesurvey, 2013e |
| Ref 17 | Bonneville Site Survey: Environmental Baseline Survey | Gardline, 2012 |
| | **Route surveys** | |
| Ref 6 | Catcher to CATS-T5 Tee (Banff) Export Pipeline Route Survey: Habitat Assessment Report. | Calesurvey, 2012f |
| Ref 12 | Catcher to CATS-T6 Tee (Judy) Export Pipeline Route Survey: Habitat Assessment Report. | Calesurvey, 2012g |
| Ref 13 | Catcher to Fulmar Export Pipeline Route Survey: Habitat Assessment Report. | Calesurvey, 2012h |
| Ref 14 | Catcher to Gannet A Export Pipeline Route Survey: Habitat Assessment Report. Report No. 105. | Calesurvey, 2012i |
| Ref 16 | Curlew Export Pipeline Route Survey. Habitat Assessment Report | Calesurvey, 2013a |
| Ref 18 | Varadero Manifold to FPSO Route. Results Report<br>Catcher Manifold to FPSO Route. Results Report<br>Burgman Manifold to FPSO Route. Results Report | Calesurvey, 2013b<br>Calesurvey, 2013c<br>Calesurvey, 2013d |

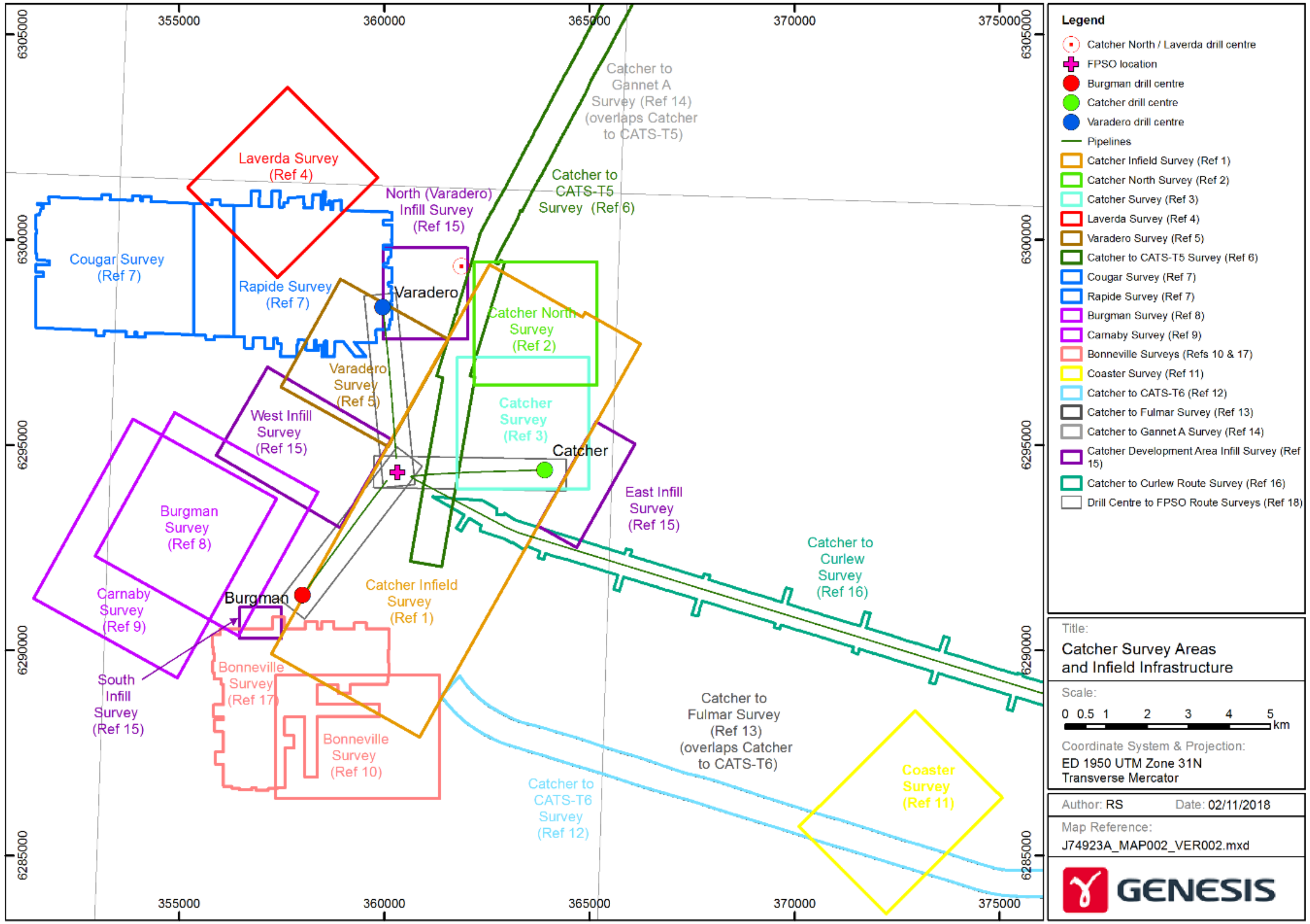



**Figure 3-1 Surveys carried out in the Vicinity of the Laverda Field Development. Note: Reference numbers correspond to reference numbers assigned to each survey in Table 3-1.**

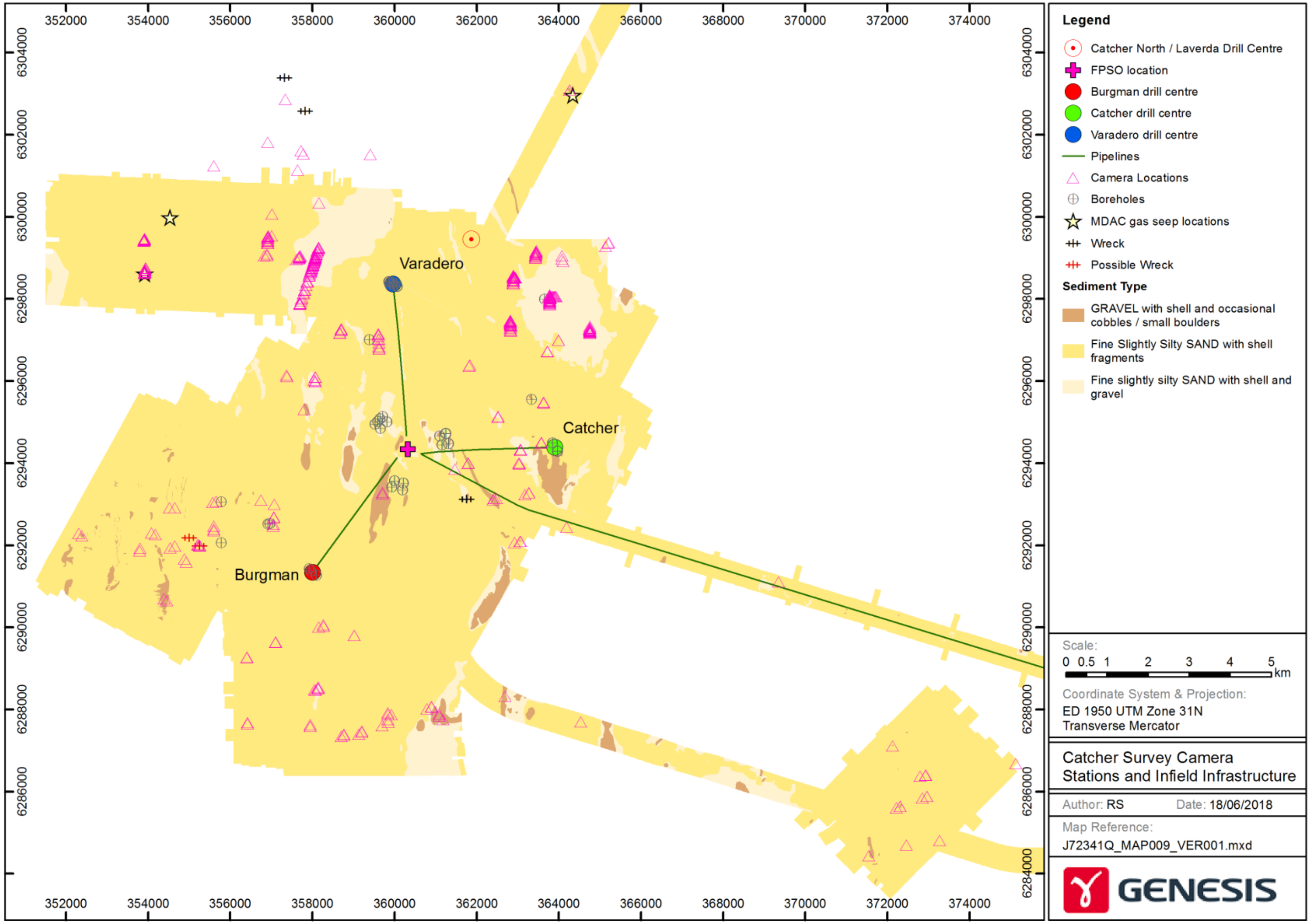



**Figure 3-2: Map Showing Location of all Seabed Imagery Taken Across the Area.**

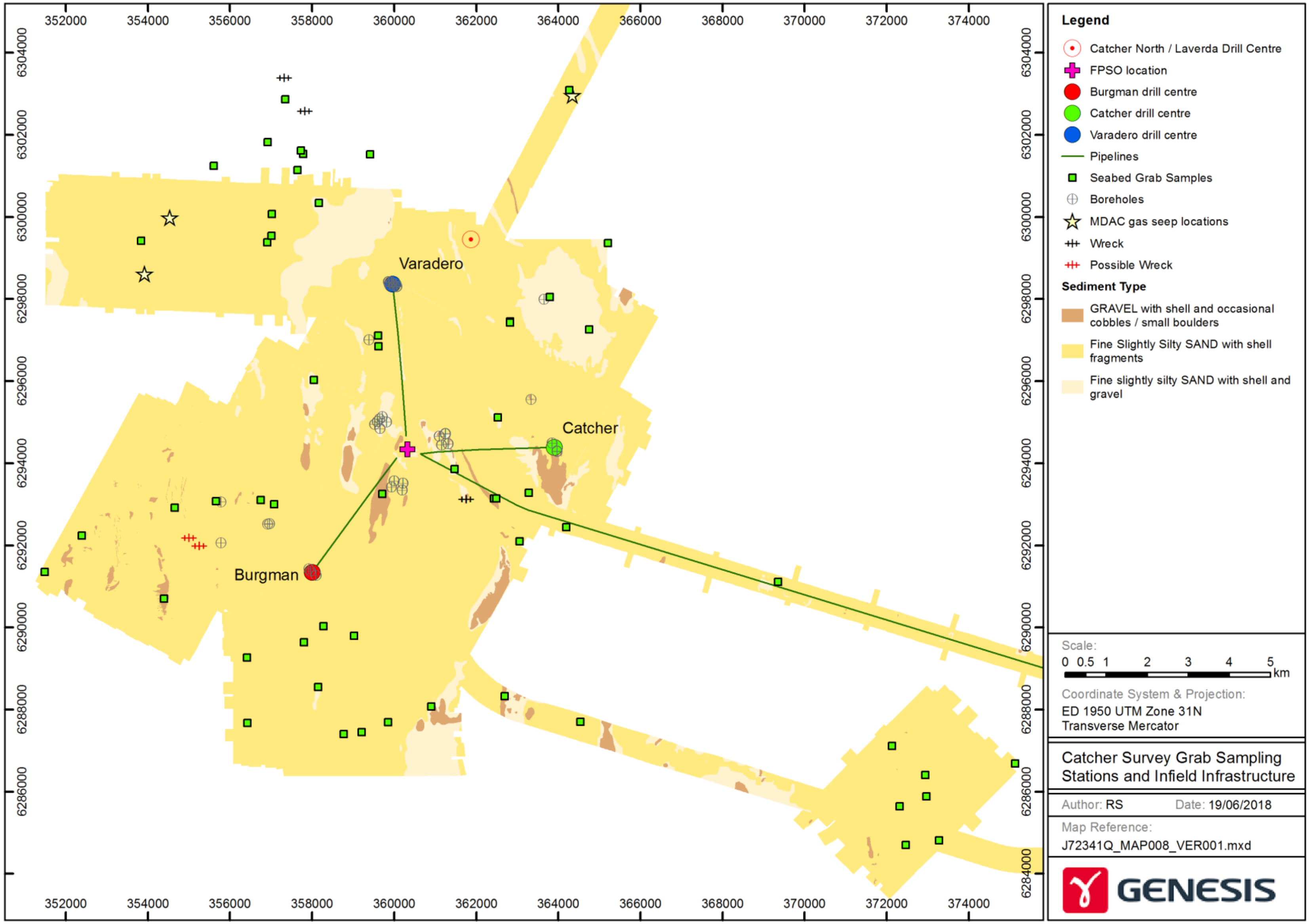



**Figure 3-3: Map Showing Location of all Grab Samples Taken Across the Area.**

## 3.2 Metocean Conditions

### 3.2.1 Bathymetry

The bathymetry derived from the various surveys shows a relatively flat seabed, with occasional deep subglacial/postglacial erosional channels (Figure 3-4).

Across the Catcher Area, depths range from a minimum of 81.0 m (Lowest Astronomical Tide (LAT)), to a maximum of 128.3 m LAT. The deeper water was associated with one of two channels identified in the area. Two bathymetric channels trend roughly north-north-west by south-south-east across the area. The western channel (located in proximity to the Varadero field) is the most significant. The channel is *c*. 600 m wide, deepens to the north and is up to 38 m deep. The eastern channel deepens to the south and splits into two outside the survey area. The proposed Laverda drilling template, is located at approximately 89 m LAT. Out with the channels, seabed gradients are generally < 0.5º. Maximum gradient observed is within the western channel at 11.4º.

Occasional localised depressions or pockmarks are present throughout the survey area, typically less than 0.5 m in depth. Some of these depressions, appear to be scours surrounding small boulders. The largest depressions occurred along the base of the channels, and are thought to be associated with the de-watering of the channel infill sediments of the Forth Formation, or the expulsion of biogenic gases created from organic matter buried within the base of the channel.

### 3.2.2 Water Currents and Tides

Local current speeds and direction influence the transport, dispersion and ultimate fate of marine discharges and materials. The general circulation within the North Sea is an anti-clockwise direction, with water entering the North Sea from the Atlantic Ocean north of Scotland and travelling down the UK east coast, to approximately the North Norfolk coastline. Here, the water current mixes with a weaker current, travelling through the English Channel.

The predominant regional current in the area, originates from the vertically well mixed coastal water, the Atlantic inflow from the north, and to a lesser extent, the Fair Isle/Dooley current which enters the North Sea, north of the Orkney Islands (Figure 3-5). The residual flow in the Central North Sea (CNS) (associated with North Sea circulation patterns), is typically 0.2 m/s towards the south (DTI, 2001); however, this generalised pattern of water movement may be influenced by short - medium term weather conditions, resulting in seasonal and annual variability. The currents are strongest at the surface.

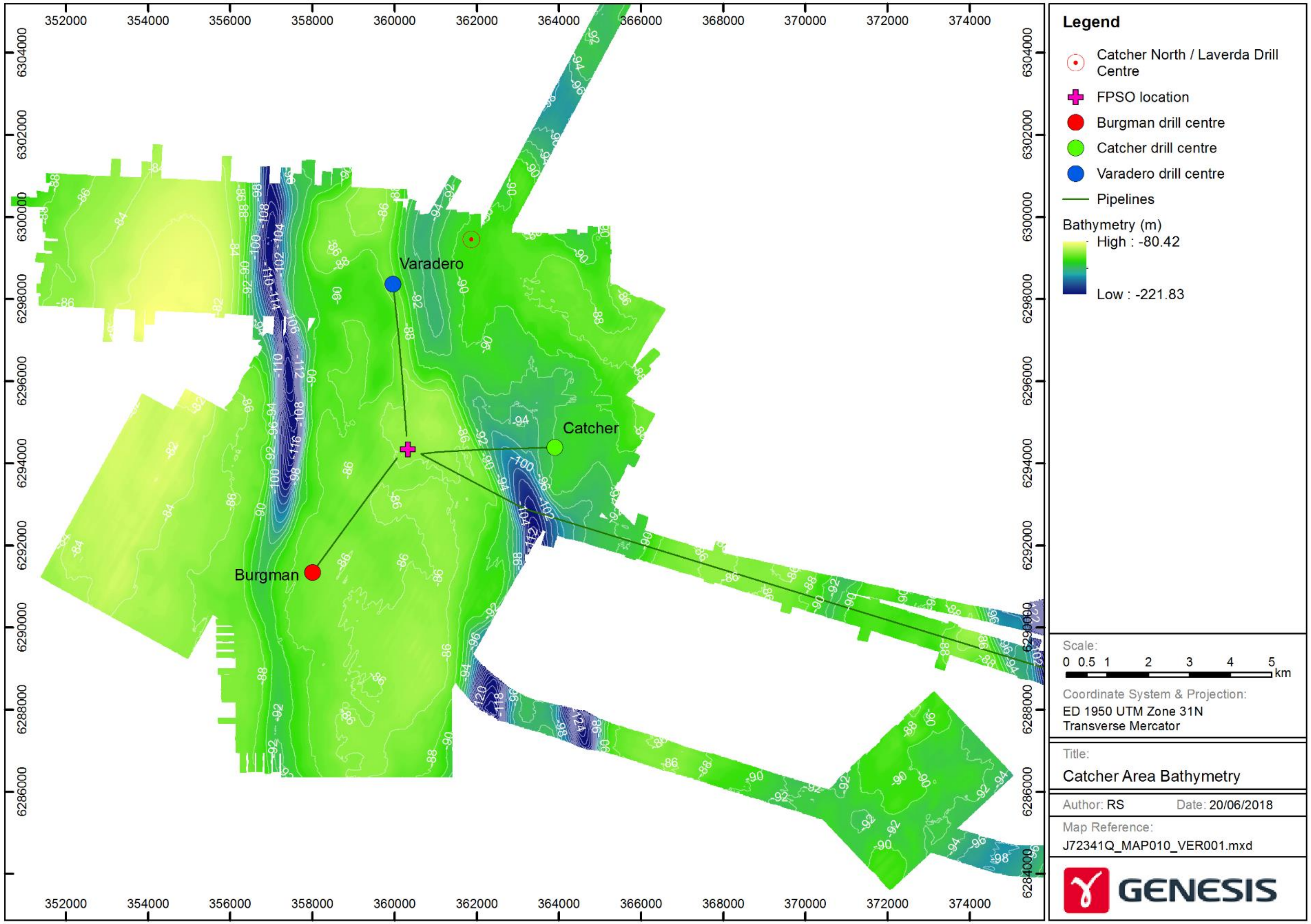



**Figure 3-4 Bathymetry and Survey Stations in the Area.**

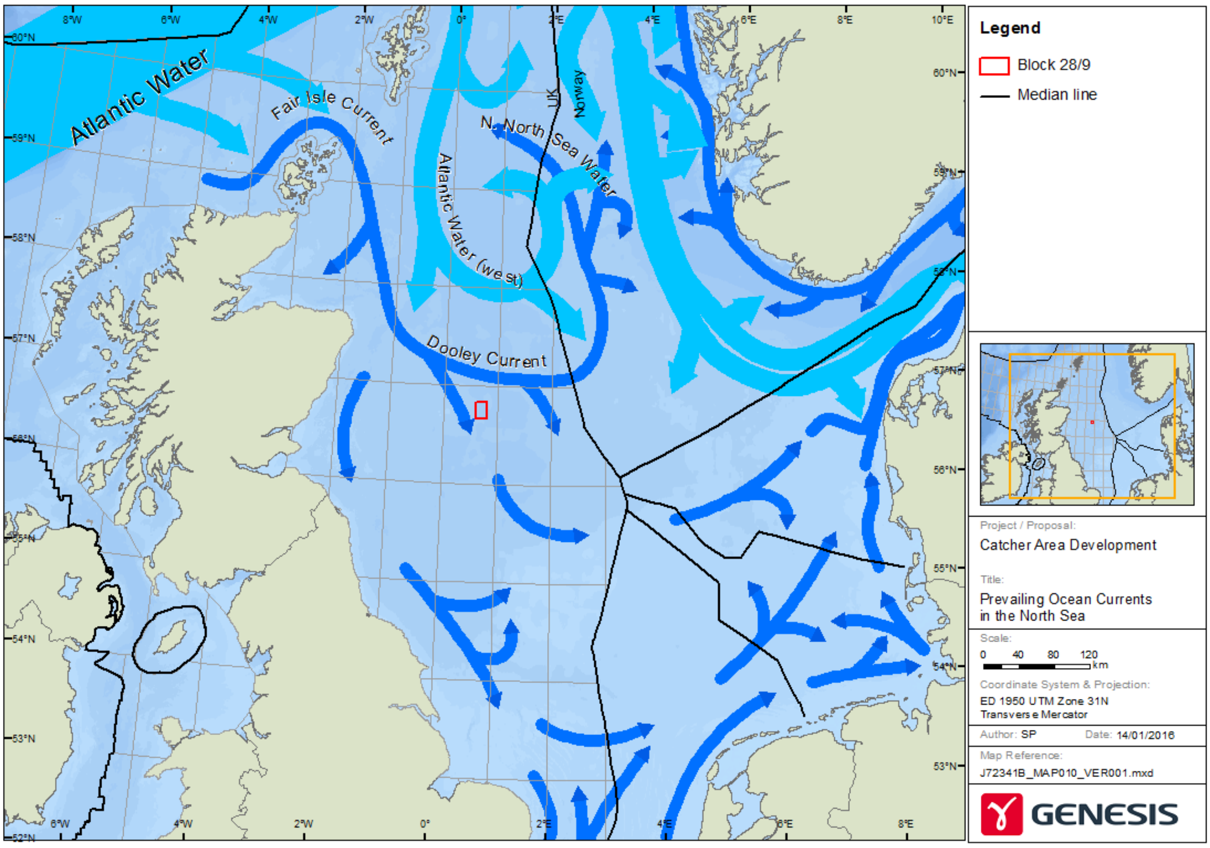



**Figure 3-5 Prevailing Currents in the North Sea (After Turrell, 1992).**

The maximum tidal current speed within the area, is *c*. 0.38 m/s (UKDMAP, 1998). Mixing in the water column, intensifies with increased tidal current speed.

### 3.2.3 Winds and Waves

Wind data spanning 140 years (1854 to 1994) across the North Sea, show the occurrence of winds from all directions, with those from the south southwest and south dominating. Predominant wind speeds throughout the year, represent moderate to strong breezes (6 to 13 m/s) with the highest frequency of gales (>17.5 m/s) during winter months (November to March). The major contrast between the northern North Sea and central and southern areas, is the relative frequency of strong winds and gales, particularly from the south. In northern areas (north of 57 °N), the percentage frequency of winds of Beaufort force 7 and above in January is > 30%, but < 20% south of 55 ºN (DTI, 2001). Figure 3-6 shows that the wind regime in Block 28/9, is consistent with the wider North Sea area (Data Explorer, 2018). The 1-year and 50-year extreme wind speeds for Block 28/9 are 27.7 m/s, and 32.7 m/s respectively. The 1-year and 50-year maximum gusts are reported as 38.3 m/s and 46.4 m/s respectively (PhysE, 2011).

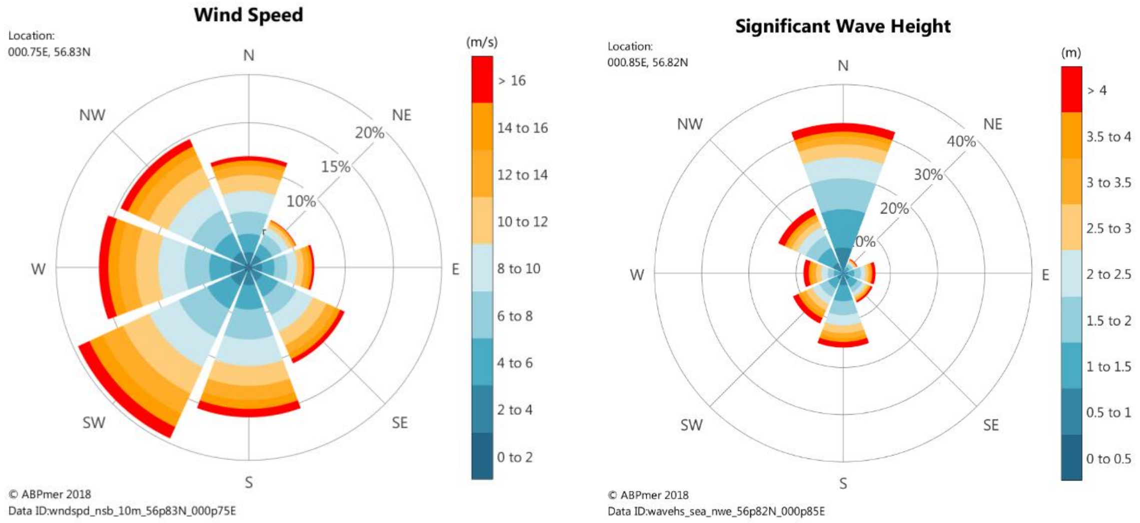



**Figure 3-6 Wind and Wave Regime in Block 28/9.**

Waves propagate predominantly from the north (Figure 3-6). The annual mean significant wave height within the area, is 2.1 to 2.7 m (Scottish Government NMPI, 2018). During storms, the re-suspension and vertical dispersion of bottom sediments due to waves and currents, affects most of the North Sea.

### 3.2.4 Water Temperature

Seawater temperatures vary with season, depth and proximity to land. A seasonal thermocline can develop during the summer months, in response to warmer surface water floating on top of cooler more dense water. This thermocline breaks down in the autumn due to seasonal cooling, and increasing frequency and intensity of storms, causing the water column to mix. Annual mean surface temperature in the area ranges from 9 to 10 ºC, and annual mean seabed temperatures range from 7 to 8 ºC (Scottish Government NMPI, 2018).

### 3.2.5 Salinity

Fluctuations in salinity are largely caused by the addition or removal of freshwater to/from seawater through natural processes, such as rainfall and evaporation. The salinity of seawater around an installation, has a direct influence on the initial dilution of aqueous effluents, such that, the solubility of effluents increases as the salinity decreases. Salinity in the Development area shows little seasonal variation, with water salinities reported as approximately 34 to 35% throughout the year (Scottish Government NMPI, 2018).

### 3.2.6 Water Quality

Regional inputs from coastal discharges and localised inputs from existing oil and gas Developments, may affect water quality in different areas of the North Sea. Water samples with the highest levels of chemical contamination within the North Sea, are generally found at inshore estuary and coastal sites, subject to high industrial usage. Where concentrations of total hydrocarbons are found to be high offshore, these are normally in the immediate vicinity of installations, originating primarily from the discharge of produced water and contaminated drill cuttings.

Hydrocarbon inputs from drill cuttings, has been essentially eliminated due to Low Toxicity Oil Based Mud (LTOBM) no longer being discharged directly to sea; implemented by the Oslo and Paris Convention (OSPAR) 2000/3. However, there is a legacy of contamination which remains in the form of historic cuttings piles around some installations, which can release hydrocarbons if disturbed by subsea works or trawling (OSPAR Commission, 2010). Concentrations of contaminants, generally fall to background levels within a very short distance of the point of discharge.

Polycyclic aromatic hydrocarbons (PAHs) generally adsorb to particulate matter/suspended solids, as they have low water solubility and are hydrophobic. Background water concentrations of PAHs, are therefore often below the limit of detection. Similarly, due to their low solubility, polychlorinated biphenyl (PCB) concentrations in water are usually extremely low (less than 1 ng/l), and difficult to detect.

Typical concentrations of total hydrocarbons (THCs), PAHs, PCBs and heavy metals in the surface waters of the North Sea, are shown in Table 3-2.

**Table 3-2 Summary of Contaminant Levels Typically Found in Surface Waters of the North Sea.**

| Location | THC (µg/l) | PAH (µg/l) | PCB (µg/l) | Nickel (µg/l) | Copper (µg/l) | Zinc (µg/l) | Cadmium (ng/l) | Mercury (ng/l) |
|---|---|---|---|---|---|---|---|---|
| Oil & Gas Installations | 1-30 | - | - | - | - | - | - | - |
| Estuaries | 12-15 | >1 | 30 | - | - | - | - | - |
| Coast | 2 | 0.02-0.1 | 1-10 | 0.2-0.9 | 0.3-0.7 | 0.5 | 10-32 | 0.25-41 |
| Offshore | 0.5-0.7 | <0.01* | - | 0.2-0.6 | 0.3-0.6 | 0.5-1.4 | 10-51 | 1.6-69 |

*Below detection levels. Source: Sheahan *et al*. (2001).

## 3.3 Sediment

The Catcher Area Development is located within an extensive area of offshore circalittoral sand (Figure 3-7).

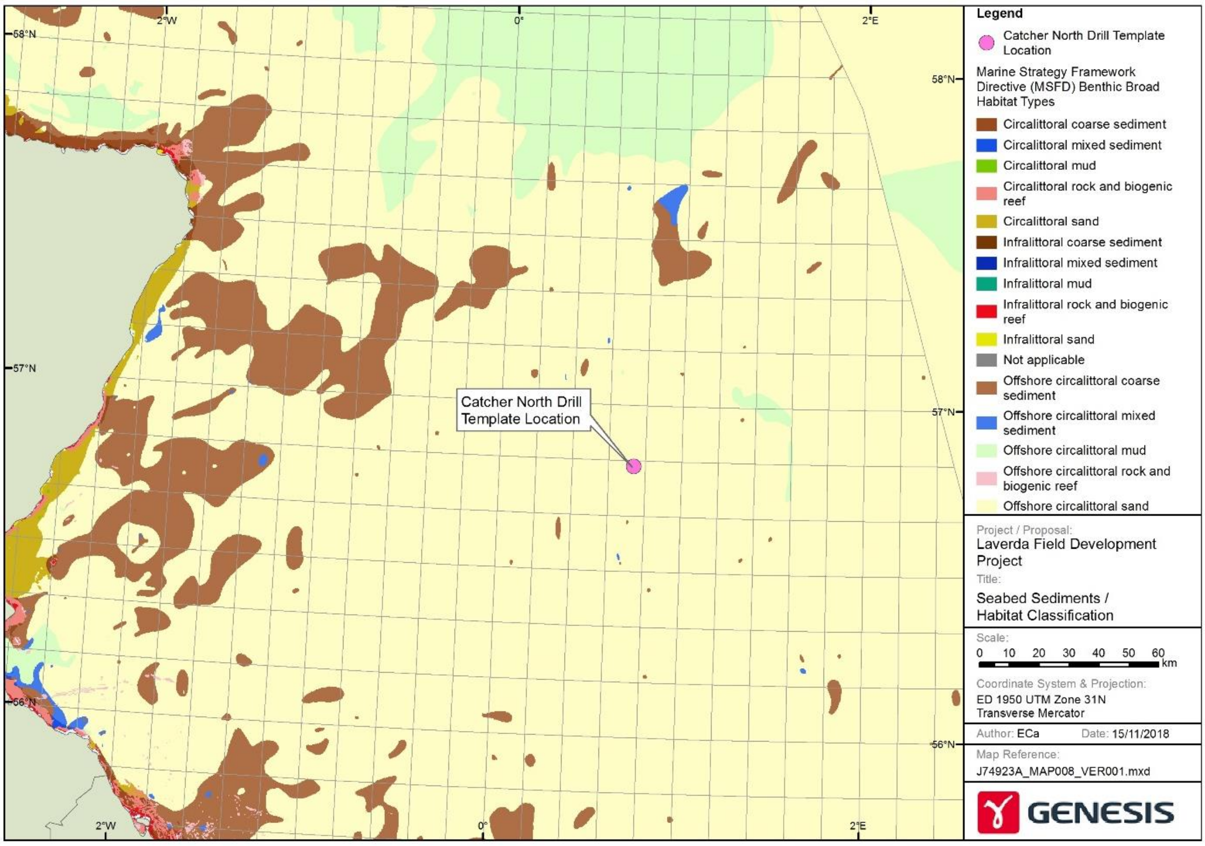



**Figure 3-7 Sediment distribution (Marine Strategy Framework Directive (MSFD) predominant habitat classification) (EMODnet, 2018).**

Between the CNDT location and the Varadero drill centre, the seabed has been interpreted to be predominantly fine slightly silty sand with shell fragments, with patchy areas of coarser sediments characterised by an increased gravel component (Calesurvey, 2013e); (Figure 3-3). The surface Holocene silty sands form a veneer thought to be around 20-50 cm thick, across most of the area. These overlie the Coal Pit Formation, which, where it is exposed at the seabed surface, is characterised by areas of hard sands, silty clays and interlaminated clays, with various admixtures of wood fragments, shells and gravels (pebbles and cobbles) thought to be drop-stones (Calegeo, 2010b; Calesurvey 2012a).

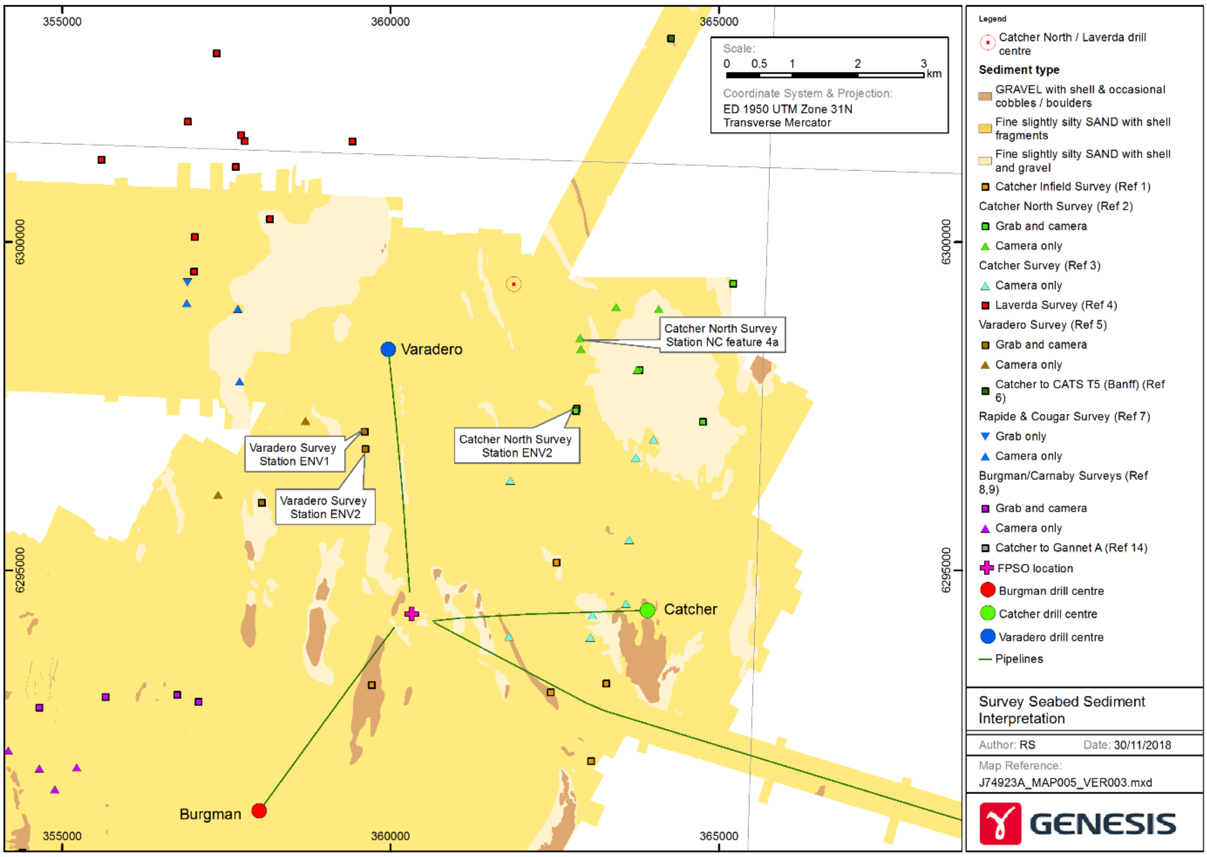



**Figure 3-8 Seabed sediments and survey stations in the area.**

The closest camera location is the Catcher North Survey Station 'NC Feature 4a', c. 1.3 km southeast of the CNDT location (Figure 3-8). This recorded seabed consists of silty fine sand, with a few shell fragments visible on the surface (Figure 3-9).

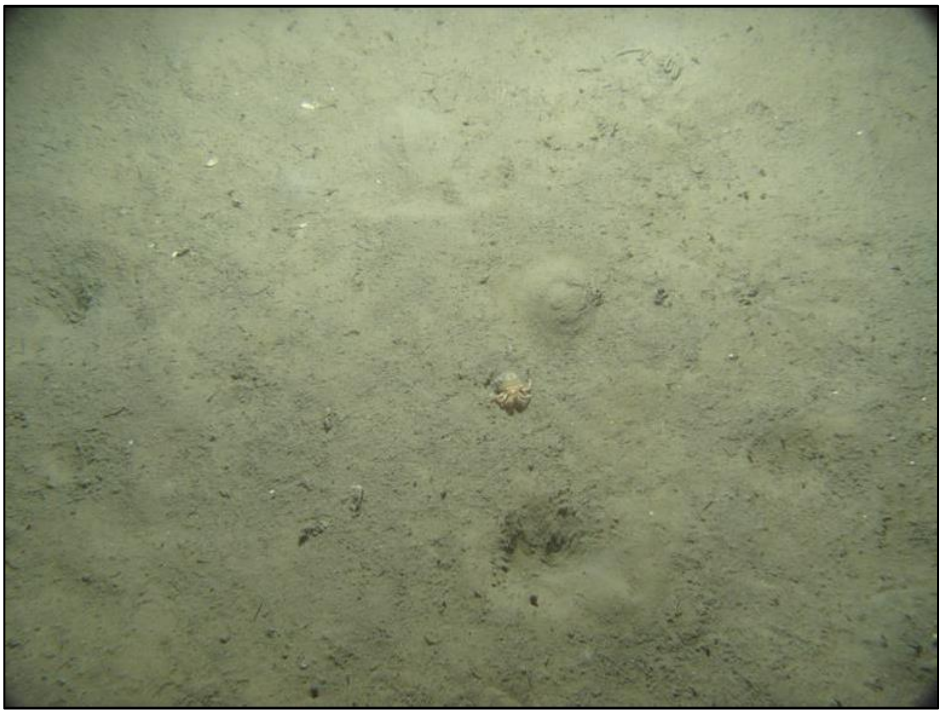


**Figure 3-9 Seabed at Catcher North Survey Station 'NC Feature 4a' with hermit crab (Calesurvey, 2012a)**

The closest grab sample locations are Varadero Survey Stations ENV1 and ENV2 (Calegeo, 2010b), and the Catcher North Survey Station ENV2 (Calesurvey 2012a) (Figure 3-8). Varadero Station ENV1, recorded silty sands with no obvious bed forms, whereas Catcher North Survey Station ENV2, recorded silty sand with a greater proportion of coarse materials, in the form of shell and gravel (Figure 3-10).

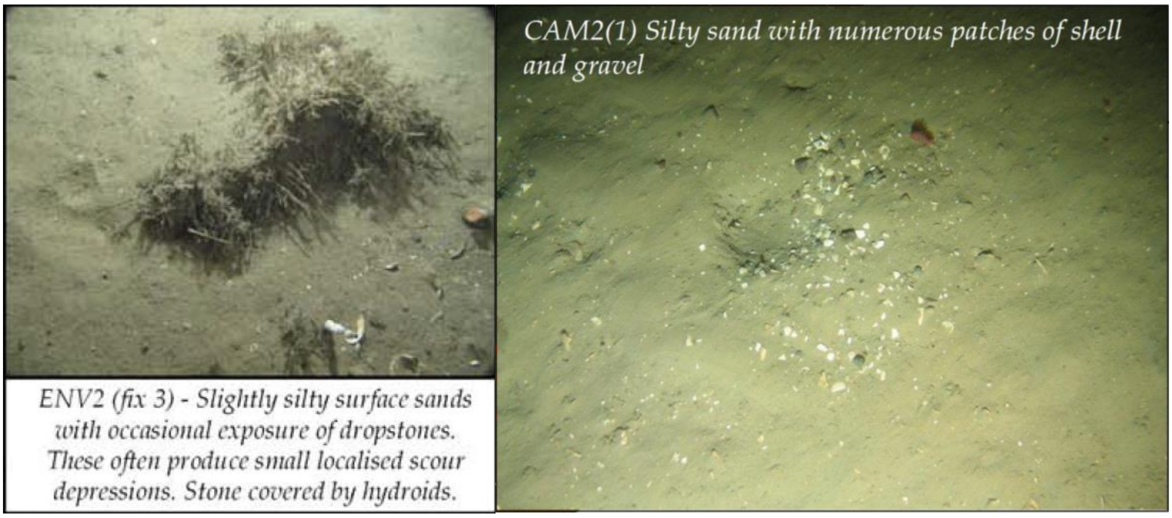



**Figure 3-10 Silty Sands in the Varadero area (left) and silty sand with shell and gravel in the Catcher area (North Catcher Survey Station ENV2) (right).**

## 3.4 Marine Flora and Fauna

This section describes the main biological receptors within the marine environment.

### 3.4.1 Plankton

The composition and abundance of plankton communities varies throughout the year, and are influenced by several factors including depth, tidal mixing, temperature stratification, nutrient availability and the location of oceanographic fronts. Species distribution is directly influenced by temperature, salinity, water inflow and the presence of local benthic communities (Robinson, 1970; Colebrook, 1982).

Seasonal stratification of the water column into layers of different temperatures, can have an important impact on phytoplankton abundance. Phytoplankton numbers usually peak in the spring, with phytoplankton communities dominated by relatively large diatoms, e.g. *Thalassiosiria* spp. and *Chaetoceros* spp. There may be an additional but smaller peak in phytoplankton numbers during the autumn, with smaller dinoflagellate species, e.g. *Ceratium,* dominating. Zooplankton communities in the North Sea are dominated by copepods, e.g. *Calanus* spp. *Acartia* spp and *Metridia lucens,* occurring during the summer peak period (Nielsen and Richardson, 1989).

### 3.4.2 Benthos

Bacteria, plants and animals living on or within the seabed sediments, are collectively referred to as the benthos. These include species living on top of the sea floor, which are collectively referred to as epibenthic organisms, and may be sessile (e.g. seaweeds) or freely moving (e.g. starfish). Animals living within the sediment (e.g. clams, tubeworms and burrowing crabs) are termed infaunal organisms. Semi-infaunal animals, including sea pens and some bivalves, lie partially buried in the seabed.

The structure and distribution of benthic communities can be explained largely by environmental parameters, including temperature, salinity, tidal / wave-induced bed stress, stratification, depth and sediment type. Their relative importance varies spatially, and many are inter-correlated (Rees *et al.*, 2007).

The Habitat Assessment reports at each of the Catcher Area Development Fields, found that faunal composition is similar throughout the Development area. The area is characterised by benthic communities associated with offshore circalittoral sand (SS.SSa.Osa), predominantly fine slightly silty sand with shell fragments. The infaunal communities of the area, are typical of moderate to low energy deep-water soft sediments in the Central North Sea area, with a community dominated by small polychaetes, both by species and abundance. The key dominant species across the area, was the omnivorous polychaete *Paramphinome jeffreysii* and the tube worm *Galathowenia oculata*, both broad ranging species recorded throughout the North East Atlantic and shelf edge areas. Six out of the eight remaining top ten species were the polychaetes; *Notomastus latericeus, Owenia fusiformis, Lumbrineris gracilis, Glycera alba, Eclysippe cf. vanelli* and *Scoloplos armiger*. The remaining species, were the holothurian (sea cucumber) *Leptosynapta bergensis* and the brittlestar *Ophiura affinis* (Calesurvey, 2013c).

Site specific surveys were carried out in the nearby Catcher and Varadero Fields between 2010 and 2013. These surveys are listed in Table 3-1, and the locations of seabed sampling is shown in Figure 3-1. A summary of the seabed habitats identified by these surveys, based on the UK Marine Habitat Classification (Conner *et al*., 2004), and of associated benthos, is presented in Table 3-3.

In some areas, the seabed is composed of a greater proportion of coarse materials in the form of shell and gravel, described as circalittoral mixed sediments (SS.SMx.OMx), and occasional drop stones provide low energy circalittoral rock (CR.LCR) habitat, with attached hydroids and occasional cup corals.

**Table 3-3 Summary of Seabed Habitats and Benthos**

| Survey | UK Marine Habitat Classification | Description |
|---|---|---|
| Catcher Survey Area (Calesurvey, 2012a) | Offshore circalittoral sand (SS.SSa.Osa) | Conspicuous sessile fauna present within areas of silty sands were limited to bryozoans, the sea pens *Pennatula phosphorea* and *Virgularia mirabilis*, and sea anenomes (actinaria). The seven-rayed scallop *Pseudamussium perlutrae*, spatangoid urchins, starfish (asteroidea), polychaete worms and empty tusk shells were observed. Mobile faunal species included several hermit crabs (Figure 3-9) including the common hermit crab *Pagurus bernhardus* often in the shells of Common Tower Shell (*Turritella communis*). |
| | A combination of:<br><br>Offshore circalittoral sand (SS.SSa.OSa)<br><br>Occasional exposure of the low energy circalittoral rock (CR.LCR) or circalittoral mixed sediments (SS.SMx.OMx). | In areas of the exposed Coal Pit Formation, softer sediment fauna, whilst still present, was rarer with less bioturbation and poorly defined animal tracks, burrows and other signs of life. Conspicuous fauna included, the sessile sea pens *P. phosphorea* (including juveniles) and *V. mirabilis*, sea anemones including the Devonshire Cup Coral (*Caryophyllia smithii*), starfish, brittlestars, polychaete tube worms and some sponges (porifera) while mobile fauna included hermit crabs (Paguroidea) including *P. bernhardus*, and the sea slug *Facelina bostoniensis.* |
| Varadero Survey Area (Calegeo, 2010b) | Offshore circalittoral sand (SS.SSa.Osa)<br><br>Very occasional and localised habitat of low energy circalittoral rock (CR.LCR) relating to drop-stones. | Conspicuous fauna were generally limited and not diverse, including juvenile starfish, hermit crabs (*Pagurus berhardus*), suspension feeding polychaete worms and the occasional sea pen (*Pennatula phosphorea*). Within areas of the exposed Coal Pit Formation, hydroids covered the exposed cobbles along with the occasional cup coral (*C. smithii*). |

No gas escape features, reefs (geological or biological) or other potential marine Annex I features, were recorded by surveys of the area. The general habitat of the area conforms to a sandier form of the UKBAP habitat designation of “Mud Habitat in Deep-Water”, also listed as “Sea pens and burrowing megafauna communities” (Calesurvey, 2012a).

Juvenile *Arctica islandica* were recorded within the Laverda survey area (Gardline, 2016) and within the Bonneville survey area (Gardline, 2012) and two adults were also recorded within the Bonneville survey area. *A. islandica* are listed by OSPAR as being under threat and/or decline in the North Sea, in addition to being a Priority Marine Feature (PMF) in Scottish waters (see Section 3.5). However, it should be noted that *A. islandica* are commonly found within the CNS.

### 3.4.3 Seabirds

The UK and its surrounding seas are very important for seabirds. The extensive network of cliffs, sheltered bays, coastal wetlands and estuarine areas, provide breeding and wintering grounds for national and internationally important bird species and assemblages (BEIS, 2016).

Predicted maximum monthly abundance of seabirds in the Catcher area, is based on an analysis of the European Seabirds at Sea (ESAS) data collected over 30 years (Kober *et al.*, 2010). Continuous seabird density surface maps, were generated using the spatial interpolation technique 'Poisson kriging', and fifty-seven seabird density surface maps were created, to show particular species distribution in specific areas. Data from the relevant maps has been summarised for the area in Table 3-4.

Distribution and abundance of these bird species vary seasonally and annually. Densities of common guillemot and Atlantic puffin are generally higher in the breeding season, whereas other species such as the black-legged kittiwake, have higher densities over the winter period.

**Table 3-4 Predicted Seabird Surface Density (maximum number of individuals/km² (Kober *et al*., 2010)).**

| Species | Season | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northern gannet | Breeding | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| Northern fulmar | Breeding | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| Black-legged kittiwake | Breeding | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| Common gull | Breeding | | | | | | | | | | | | |
| Great black-backed gull | Breeding | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| Razorbill | Breeding | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| | Additional | | | | | | | | | | | | |
| Great skua | Breeding | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| Little auk | Winter | | | | | | | | | | | | |
| Common guillemot | Breeding | | | | | | | | | | | | |
| | Additional | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| Atlantic puffin | Breeding | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |
| All species combined | Breeding | | | | | | | | | | | | |
| | Summer | | | | | | | | | | | | |
| | Winter | | | | | | | | | | | | |

| KEY | Not recorded | ≤ 1.0 | 1.0 – 5.0 | 5.0 – 10.0 | 10.0 - 15.0 | 15.0 - >20.0 |
|---|---|---|---|---|---|---|

In general, seabirds feeding or resting on the sea surface, are most vulnerable to water-borne pollution. The aerial habits of fulmars and gulls, together with their large populations and widespread distribution, reduce their vulnerability to oil related pollution. Auks (e.g. guillemots, razorbills, and puffins) are most vulnerable in the post-breeding season (July to August), when they become flightless during periods of moult, thus spending large amounts of time on the water surface. Generally, vulnerability is lowest during the pre-breeding and breeding months, increasing as the breeding season ends, and birds disperse into offshore waters (Stone *et al.,* 1995).

Oil and Gas UK commissioned HiDef (a digital aerial video and image specialist consultancy) to develop the Seabird Oil Sensitivity Index (SOSI) tool, and the results are available on the JNCC website (JNCC, 2017).

The SOSI combines the seabird survey data (from 1995 - 2015) with individual seabird species sensitivity index values. These values are based on a number of factors, which are considered to contribute towards the sensitivity of seabirds to oil pollution, and include:

- Habitat flexibility (the ability of a species to locate to alternative feeding grounds),
- Adult survival rate,
- Potential annual productivity, and
- The proportion of the biogeographical population in the UK (classified following the methods developed by Certain *et al*., (2015).

The combined seabird data and species sensitivity index values, were subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution. The index indicates where the highest seabird sensitivities might lie, if there were to be a pollution incident (JNCC, 2017).

As can be seen from Table 3-5 and Figure 3-11, the sensitivity of birds to surface oil pollution in Block 28/9 and the immediately adjacent Blocks is considered low, throughout most of the year. Exceptions are Blocks 28/14 and 28/15, where seabird sensitivity is considered high and very high respectively, for the months of September and October. There is no data available for November.

**Table 3-5 SOSI for Block 28/9 and Adjacent Blocks.**

| Block | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28/3 | 5 | 5 | 5 | 5* | 5* | 5 | 5 | 5 | 5 | 5* | N | 5* |
| 28/4 | 5 | 5 | 5 | 5* | 5* | 5 | 5 | 5 | 5 | 5* | N | 5* |
| 28/5 | 5 | 5 | 5 | 5* | 5* | 5 | 5 | 5 | 5 | 5* | N | 5* |
| 28/8 | 5 | 5 | 5 | 5* | 5* | 5 | 5 | 5 | 5 | 5* | N | 5* |
| 28/9 | 5 | 5 | 5 | 5* | 5* | 5 | 5 | 5 | 5 | 5* | N | 5* |
| 28/10 | 5 | 5 | 5 | 5* | 5* | 5 | 5 | 5 | 5 | 5* | N | 5* |
| 28/13 | 5 | 5 | 5* | N | N | 5* | 5 | 5 | 5 | 5* | N | 5* |
| 28/14 | 5 | 5 | 5 | 5* | N | 5* | 5 | 5 | 3 | 3* | N | 5* |
| 28/15 | 5 | 5 | 5 | 5* | 5* | 5 | 5 | 5 | 2 | 2* | N | 5* |

| Key | 1 | 2 | 3 | 4 | 5 | N | * |
|---|---|---|---|---|---|---|---|
| | Extremely High | Very High | High | Medium | Low | No Data | Indirect Assessment |

The values in the Table has been populated where necessary using an indirect assessment, following guidance provided by the JNCC (JNCC, 2018a).

** data gap filled using data from the same block in adjacent months.*

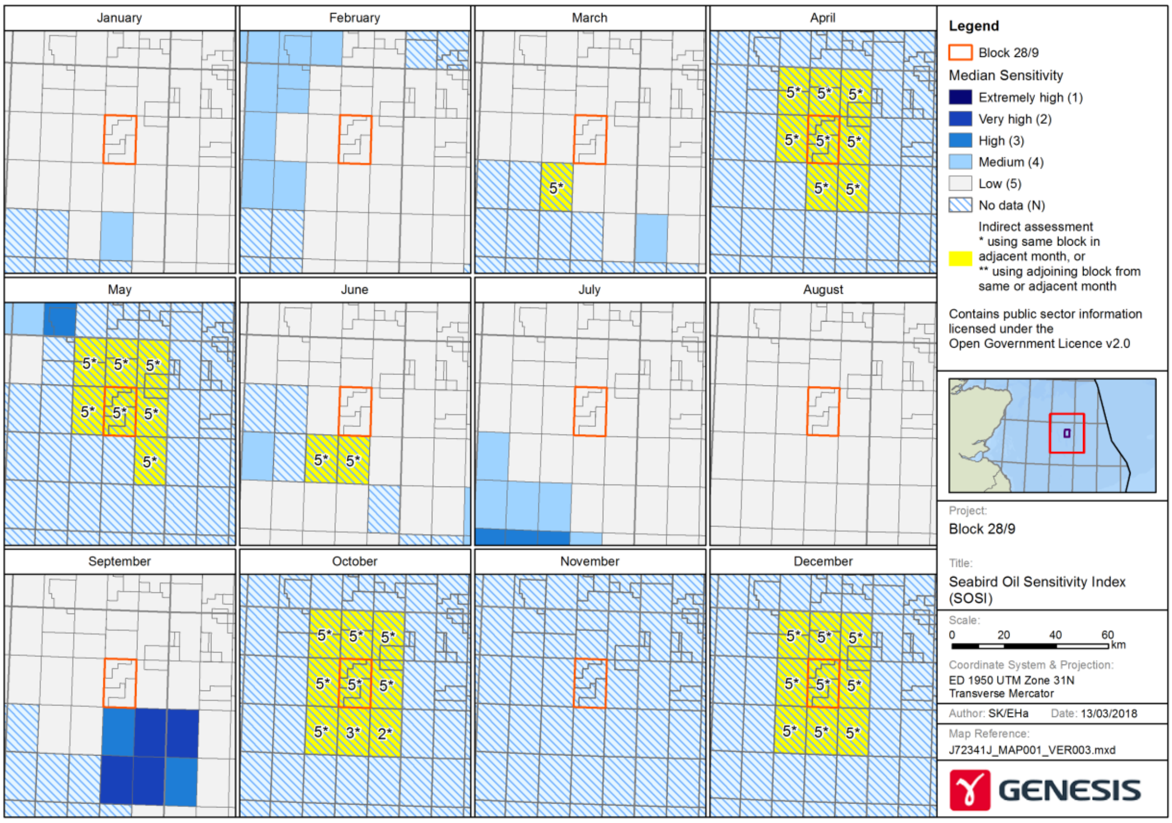



**Figure 3-11 Monthly Seabird Vulnerability to Surface Pollution in Block 28/9.**

### 3.4.4 Fish

At present, more than 330 fish species are thought to inhabit the shelf seas of the UKCS (Pinnegar *et al*., 2010). Many of these species are widespread across the North Sea, having extended spawning and nursery grounds. The most vulnerable stages of the fish lifecycle to general disturbances such as disruption to sediments and chemical / hydrocarbon discharges, are the egg and larval stages, hence recognition of spawning and nursery grounds within an area of Development is important.

Some of the commercial species with recognised spawning and nursery grounds in the area, are listed in Table 3-6 and illustrated in Figure 3-12 (Coull *et al*., 1998).

**Table 3-6 Spawning and Nursery Areas of Commercial Fish Species Within Block 28/9 (ICES Rectangle 42F0) (Coull *et al*.,1998).**

| Species | J | F | M | A | M | J | J | A | S | O | N | D | Nursery |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cod | | | | | | | | | | | | | |
| Mackerel | | | | | | | | | | | | | |
| Lemon sole | | | | | | | | | | | | | |
| Norway pout | | | | | | | | | | | | | |
| Haddock | | | | | | | | | | | | | |
| Sandeel | | | | | | | | | | | | | |
| **Key** | Spawning | | | | | | | Peak Spawning | | | | | |

Additionally, Ellis *et al.* (2012) identified low densities of juvenile anglerfish, blue whiting, cod, European hake, herring, ling, mackerel, plaice, sandeel, spurdog and whiting within the area, indicating the presence of nursery grounds for these species. Using Species Distribution Modelling (SDM), Aires *et al*. (2014) predicted the location of aggregations of 0-group fish (fish in their first year of life) based on environment information and catch records. They found 0-group fish for a number of species present in the vicinity. Figure 3-13 shows the probability of juvenile fish for some species, being present at any one time in the area. In addition to those identified by Ellis *et al*., (2012), these include haddock, sprat and Norway pout juveniles.

It should be noted that spawning and nursery areas tend to be transient, and therefore cannot be defined with absolute accuracy (Coull *et al*., 1998; Ellis *et al*., 2012).

Of the fish species known to occur in the area, a number of them are considered PMFs: blue whiting, Norway pout, sandeel and mackerel (see Section 3.5).

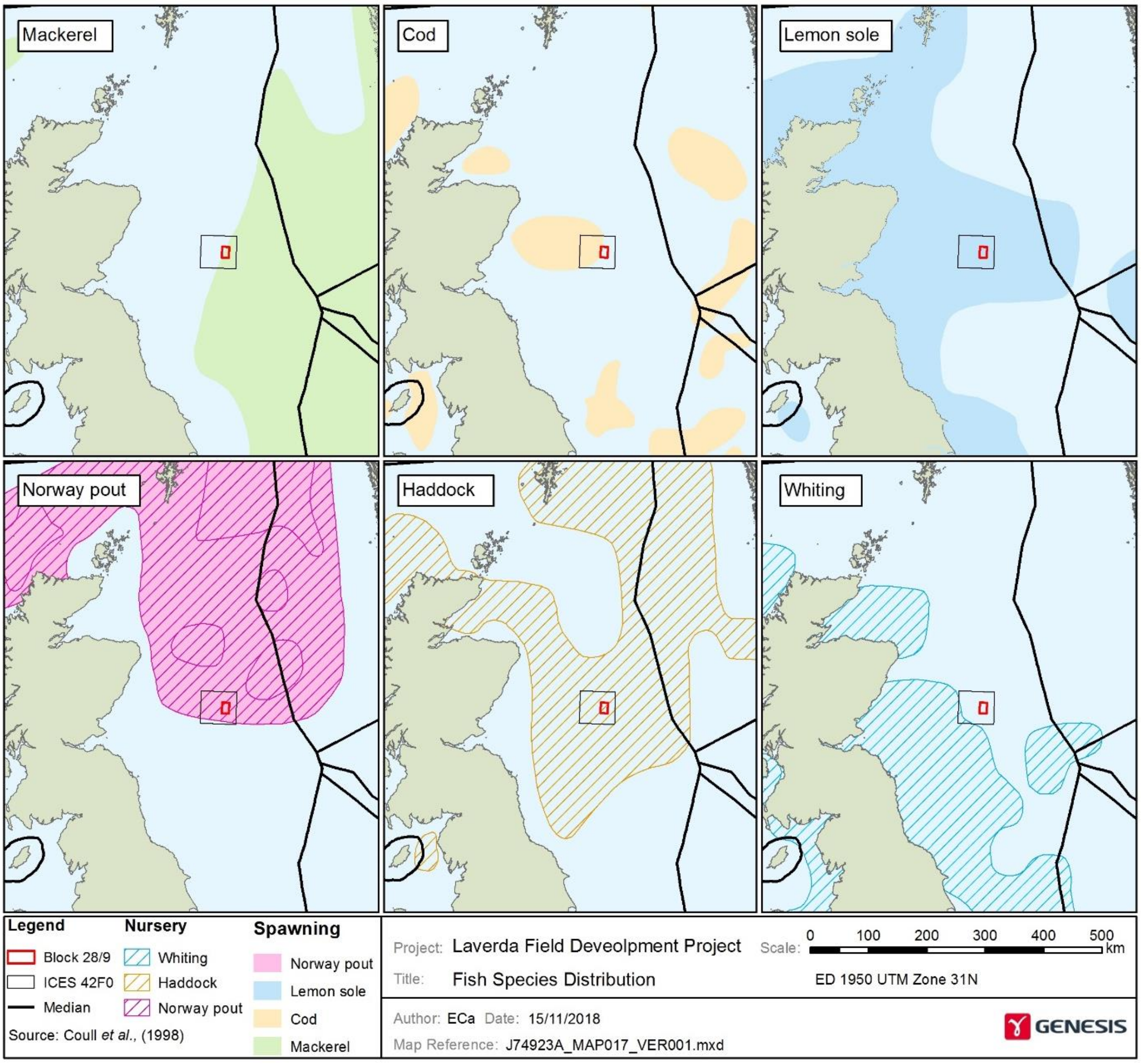



**Figure 3-12 Fish Spawning and Nursery Areas in the Vicinity of Block 28/9 (data from Coull *et al*., 1998).**

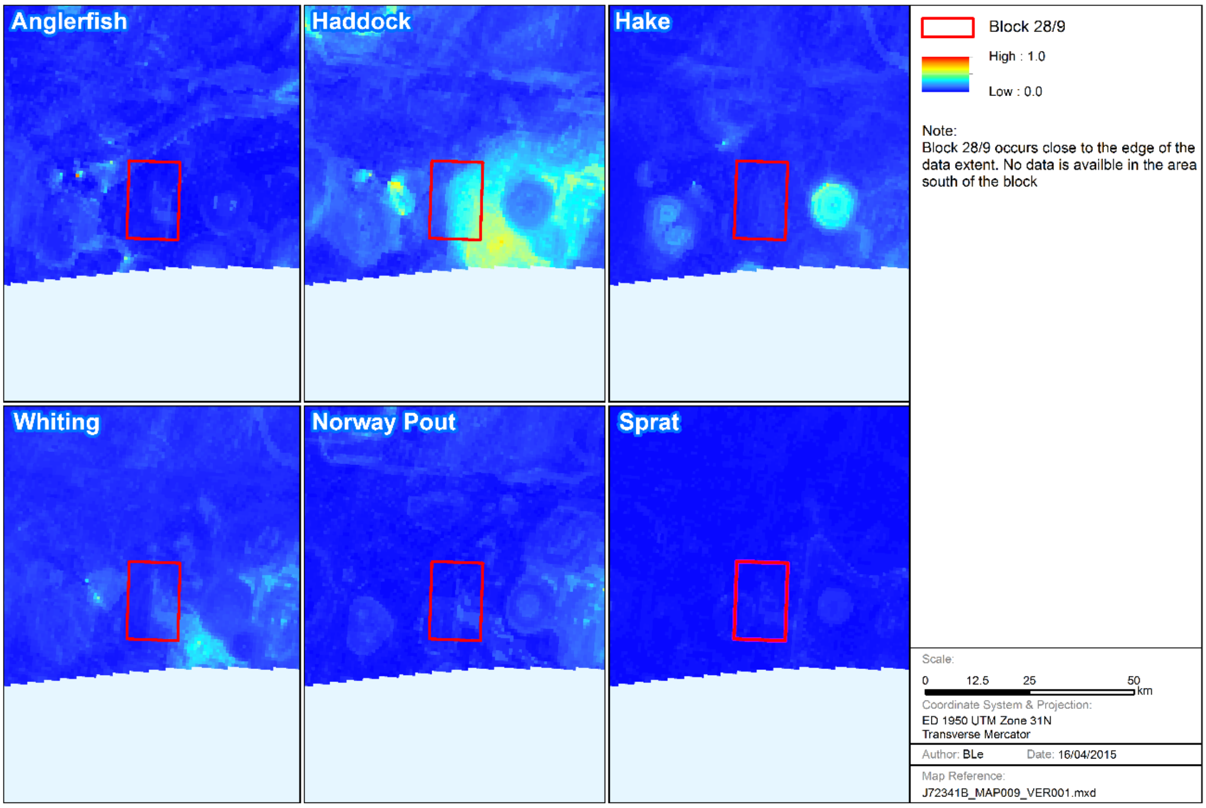



**Figure 3-13 Probability of Juvenile Fish in the Vicinity of Block 28/9.**

#### 3.4.4.1 Sharks, Skates and Rays

Due to their slow growth rates and hence delayed maturity and relatively low reproductive rates, sharks, rays and skates (all Elasmobranchs), tend to be vulnerable to anthropogenic activities. Historically, Elasmobranch species have been targeted by commercial fisheries (specifically common skate, long-nose skate and angel shark), and overfishing has significantly depleted their numbers in the North Sea. More recently, these species tend to be taken as bycatch to such an extent, that stocks are still being depleted in UK waters. Work is underway to develop National Plans of Action for the conservation and management of the Elasmobranchs. Those species identified as being in need of immediate protection, are the angel shark, common skate, longnose skate, Norwegian skate and white skate. It has been proposed to protect these species in UK waters, in the same way as the basking shark is protected under the Wildlife and Countryside Act (1981). Basking sharks, which are a protected species, have not been recorded in the area (Marine Conservation Society, 2006).

The distribution of Elasmobranchs in the UKCS is not extensively documented; however, available literature (Ellis *et al*., 2004) suggests that at least five species are present in the North Sea:

- Spiny dogfish;
- Tope shark;
- Thorny skate / starry ray;
- Cuckoo ray;
- Lesser spotted dogfish.

Total numbers recorded for each of these species are low (Ellis *et al*., 2004).

### 3.4.5 Marine Mammals

#### 3.4.5.1 Cetaceans

Cetaceans regularly recorded in the North Sea include harbour porpoise, white-beaked dolphin, minke whale, Atlantic white-sided dolphin, bottlenose dolphin (primarily in inshore waters) and killer whale (Reid *et al.*, 2003). Risso's dolphin and large baleen whales are also occasionally sighted. Spatially and temporally, harbour porpoise, white-beaked dolphin and minke whale, are the most commonly sighted cetacean species in the North Sea (Reid *et al.,* 2003). The JNCC has compiled an atlas of cetacean distribution in northwest European waters (Reid *et al*., 2003), which gives an indication of the types of cetaceans and times of the year that they are likely to frequent areas of the North Sea. Table 3-7 lists the cetacean species known to occur in the area of the Laverda Field Development, which include harbour porpoise (*Phocoena phocoena*), minke whale (*Balaenoptera acutorostrata*), white-beaked dolphin (*Lagenorhynchus albirostris*) and Atlantic white-sided dolphin (*Lagenorhynchus acutus*). All these species are identified as PMFs (see Section 3.5).

**Table 3-7 Cetacean Sightings in the Vicinity of the Laverda Field Development (Reid *et al.*, 2003).**

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Atlantic white-sided dolphin | | | | | | | | | | | | |
| Harbour porpoise | | | | | | | | | | | | |
| Minke whale | | | | | | | | | | | | |
| White-beaked dolphin | | | | | | | | | | | | |
| Species recorded | | | | Species not recorded | | | | | | | | |

A series of Small Cetacean Abundance in the North Sea (SCANS) surveys, have been conducted to obtain an estimate of cetacean abundance in the North Sea and adjacent waters, the most recent of which, is SCANS-III (Hammond *et al*., 2017). Ariel and shipboard surveys were carried out during the summer of 2016, to collect data on the abundance of harbour porpoise, bottlenose dolphin, Risso's dolphin, white-beaked dolphin, white-sided dolphin, common dolphin, striped dolphin, pilot whale, all beaked whale species combined, sperm whale, minke whale and fin whale.

The Laverda Field Development is located within area "R". Aerial survey estimates of animal abundance and densities (animals per $km^2$) within this area, are provided in Table 3-8 (Hammond *et al*., 2017). The data confirms that harbour porpoise, minke whale, white-beaked dolphin and white-sided dolphin may occur in the area of the proposed activities and suggests that bottlenose dolphin (*Tursiops truncatus*) may also be present.

The JNCC have published the 'regional' population estimates for the seven most common species of cetacean occurring in UK waters (Inter-Agency Marine Mammal Working Group IAMMWG, 2015). Divided into Management Units (MUs), the estimated abundance of animals in these MUs, are currently considered the reference populations for cetacean species in the North and Celtic Seas. Phase III of the Joint Cetacean Protocol, provides abundance estimates (adjusted average summer density surfaces from 2007-2010) which can be used to scale the MU populations, to provide a reference population estimate for any given area (Paxton *et al*., 2016). These abundance estimates provide an indication of the spatial scale and the relevant populations at which impacts should be assessed. The relevant MUs and population sizes are presented in Table 3-8.

**Table 3-8 SCANS-III Densities for Marine Mammals in the Vicinity of the Block 28/9 (Hammond *et al*., 2017) and Relevant MU Populations (IAMMWG, 2015).**

| Species | Density (animals / km$^2$) | Relevant MU and population size |
|---|---|---|
| Harbour porpoise | 0.599 | North Sea<br>333,808 |
| Minke whale | 0.039 | Celtic and Greater North Sea<br>11,819 |
| White-beaked dolphin | 0.243 | Celtic and Greater North Sea<br>35,908 |
| White-sided dolphin | 0.01 | Celtic and Greater North Sea<br>2,197 |
| Bottlenose dolphin | 0.03 | Greater North Sea<br>1,971 |

#### 3.4.5.2 Pinnipeds

Two species of seal live and breed in UK waters: the grey seal (*Halichoerus grypus*) and the harbour (also called common) seal (*Phoca vitulina*). Both species are listed as Annex II species under the European Union (EU) Habitats Directive.

The foraging range of the harbour seal is typically within 40 – 50 km of their haul out site. Tracking of individual grey seals has shown that they can feed up to several hundred kilometres offshore, although most foraging tends to be within approximately 100 km (SCOS, 2011). Distribution maps based on telemetry data (1991-2012) and count data (1988-2012) indicate that harbour seals are very unlikely to be present in the vicinity of the Laverda Field Development, whilst grey seals occur in low densities (1 - 5 individuals per 25 km) (SMRU, 2017) (Figure 3-14).

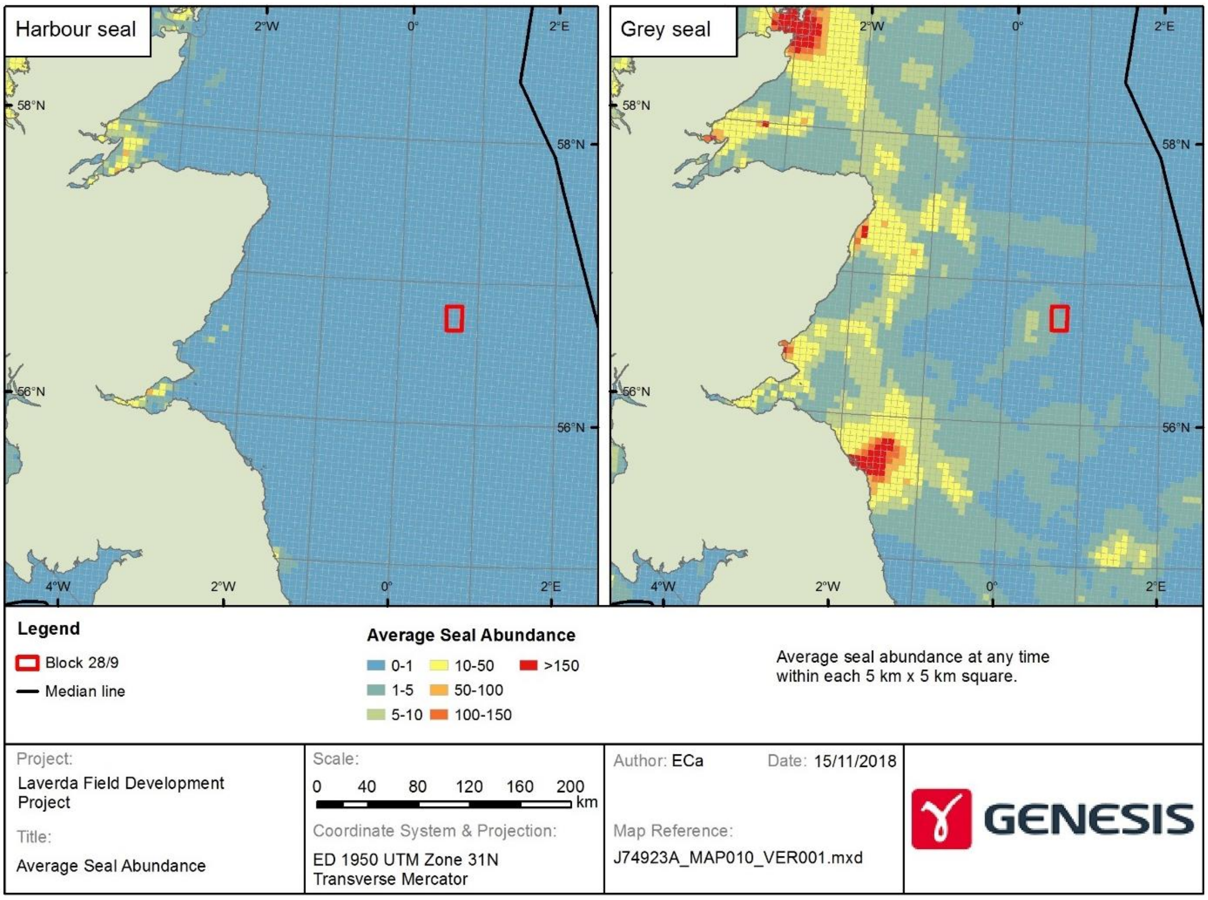



**Figure 3-14 Harbour and Grey Seal distribution in the North Sea (SMRU, 2017).**

## 3.5 Protected Sites and Species

A network of Marine Protected Areas (MPAs) are in place to aid the protection of vulnerable and endangered species and habitats, through structured legislation and policies. These sites include Special Areas of Conservation (SAC) and Special Protection Areas (SPA), designated under the EC Habitats Directive (92/43/EEC) and EC Birds Directive (2009/147/EC) respectively, along with Nature Conservation Marine Protected Areas (NCMPAs) designated under the Marine (Scotland) Act 2010 or the Marine and Coastal Access Act 2009. The Marine and Coastal Access Act 2009 (Part 5), enables the Department for Environment Food and Rural Affairs (Defra) to designate and protect Marine Conservation Zones (MCZs) in England and Wales. The protected sites within the region are illustrated in Figure 3-15. Of the different designated areas, the nearest is the East of Gannet and Montrose Fields NCMPA which is located over 34 km from the proposed CNDT location and is therefore unlikely to be impacted by the planned activities.

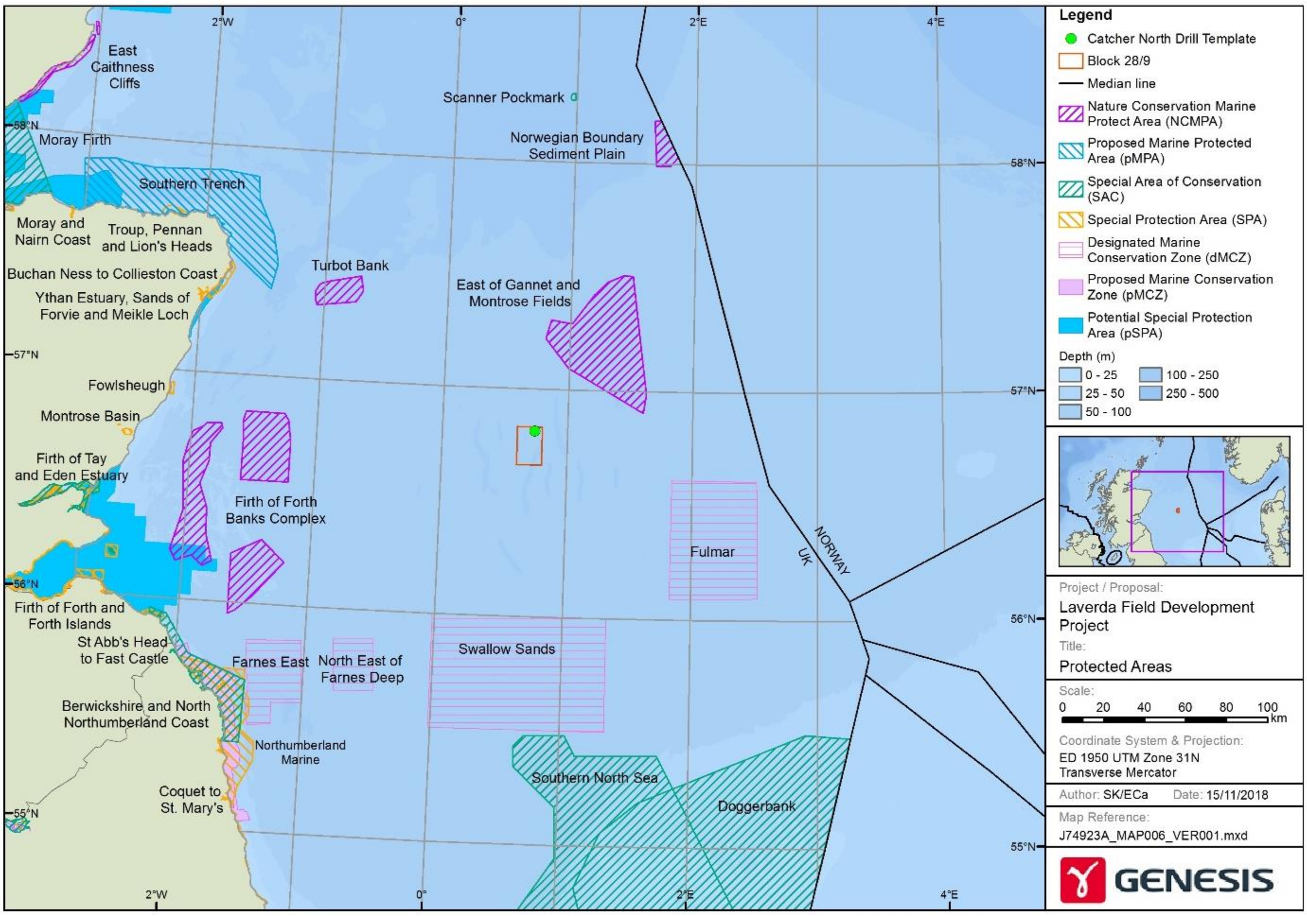



**Figure 3-15: Location of the Catcher North Drill Template in Relation to Protected Areas.**

In addition to the features to be protected via MPAs, as part of the Scottish MPA Project, SNH and JNCC have compiled a separate list of 80 habitats and species, termed Priority Marine Features (PMFs) which are considered to be of particular importance in Scotland's seas. The purpose of this list is to guide policy decisions regarding conservation in Scottish waters. The following PMFs species are potentially of highest relevance to the proposed Laverda Field Development (Tyler-Walters, 2016):

<u>Mobile Species (fish)</u>

- Blue whiting
- Norway pout
- Sandeel
- Mackerel

<u>Mobile Species (cetaceans)</u>

- Atlantic white-sided dolphin
- Harbour porpoise
- White-beaked dolphin
- Minke whale

<u>Low or limited mobility species (benthos)</u>

- *A. islandica*

## 3.6 Socio-Economic Environment

### 3.6.1 Commercial Fishing

Block 28/9 occurs within International Council for the Exploration of the Seas (ICES) rectangle 42F0. As shown in Table 3-9, the fishing effort for this area varies annually, with a mean fishing effort of *c*. 384 days between 2013 and 2017 for UK vessels over 10 m (Scottish Government, 2018). To put this into context, the fishing effort within 42F0 is considered low, contributing an average of 0.27% of UK total fishing effort between 2013 – 2017. Figure 3-16 illustrates the distribution of fishing effort in the wider area (Scottish Government, 2018).

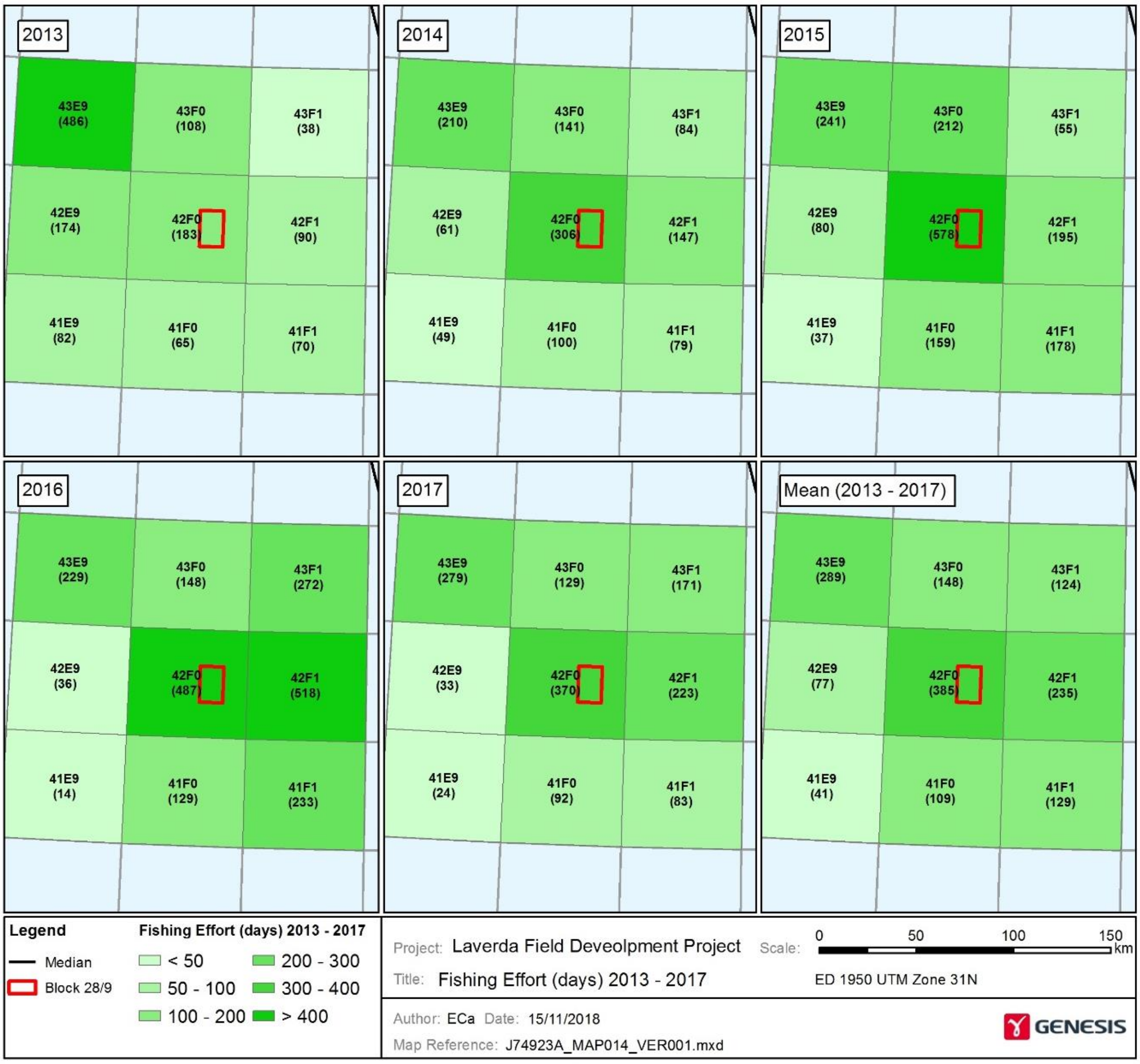



**Figure 3-16 Fishing effort (in days) between 2013 – 2017 in ICES 42F0 and adjacent rectangles (Scottish Government, 2018).**

**Table 3-9 Fishing effort (days by UK fishing fleet in ICES rectangle 42F0) (Scottish Government, 2018).**

| Year | Total Fishing Effort by UK Fishing Fleet (days) | | |
|---|---|---|---|
| | UK total | 42F0 total | 42F0 as % of UK total |
| 2013 | 183,413 | 183 | **0.10** |
| 2014 | 129,850 | 306 | **0.24** |
| 2015 | 126,406 | 578 | **0.46** |
| 2016 | 133,319 | 487 | **0.37** |
| 2017 | 126,863 | 370 | **0.29** |
| **Average** | **139,970** | **384** | **0.27** |

Demersal, pelagic and shellfish species targeted within 42F0, represent an average of 0.29%, 0.05% and 0.16% respectively, of the total reported UK landings by weight between 2013 and 2017 (Table 3-10). This suggests that the area is of relatively low value to the UK fishing industry. Landings of demersal species were dominant in terms of weight in the majority of years between 2013 - 2017 (with exception to 2013). However, shellfish landings were the most valuable in ICES rectangle 42F0 over this period, likely because targeted shellfish include species with a high market value (Figure 3-17).

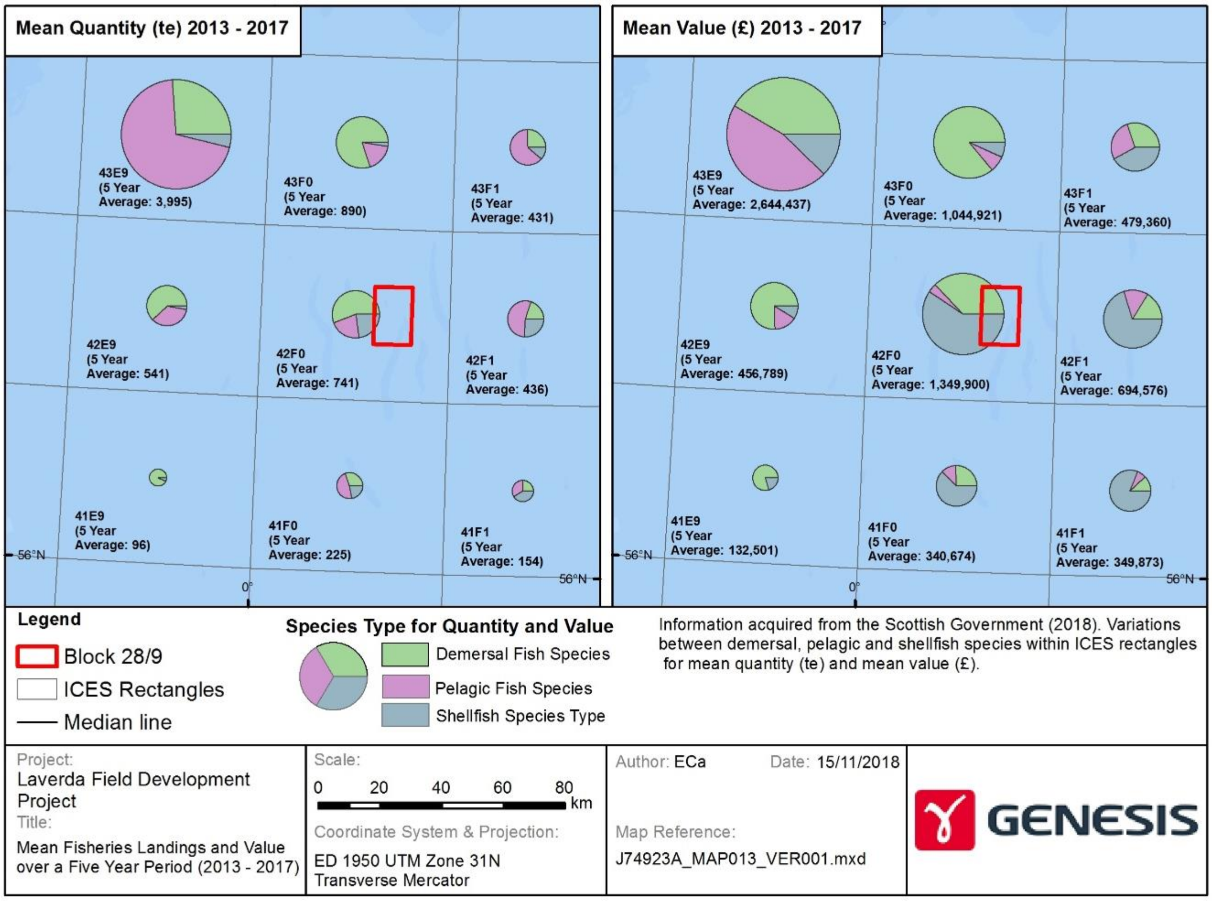



**Figure 3-17 Five-year average of fisheries landings by weight (te) and value (£) in the UKCS for rectangle 42F0 and adjacent rectangles.**

**Table 3-10 Landings from 42F0 between 2013 – 2017 (Scottish Government, 2018).**

| Year | Species type | UK total quantity (tonnes) | 42F0 total quantity (tonnes) | 42F0 as % of UK total |
|---|---|---|---|---|
| **2013** | Demersal | 184,852 | 335 | 0.18 |
| | Pelagic | 302,719 | 738 | 0.24 |
| | Shellfish | 153,360 | 32 | 0.02 |
| | **Total** | **640,931** | **1,105** | **0.17** |
| **2014** | Demersal | 129,879 | 590 | 0.45 |
| | Pelagic | 377,581 | 48 | 0.01 |
| | Shellfish | 96,721 | 151 | 0.16 |
| | **Total** | **604,181** | **789** | **0.13** |
| **2015** | Demersal | 131,135 | 636 | 0.49 |
| | Pelagic | 324,130 | 1 | 0.0002 |
| | Shellfish | 92,015 | 214 | 0.23 |
| | **Total** | **547,280** | **851** | **0.16** |
| **2016** | Demersal | 136,706 | 255 | 0.19 |
| | Pelagic | 325,658 | 0.3 | 0.00009 |
| | Shellfish | 101,695 | 233 | 0.23 |
| | **Total** | **564,059** | **488.3** | **0.42** |
| **2017** | Demersal | 128,952 | 248 | 0.19 |
| | Pelagic | 342,411 | 2 | 0.0006 |
| | Shellfish | 92,349 | 219 | 0.24 |
| | **Total** | **563,712** | **469** | **0.08** |
| **Average** | Demersal | 142,305 | 413 | 0.29 |
| | Pelagic | 334,500 | 158 | 0.05 |
| | Shellfish | 107,228 | 170 | 0.16 |
| | **Total** | **584,033** | **740** | **0.13** |

### 3.6.2 Shipping

Shipping density is considered to be moderate in Block 28/9 (DECC, 2014) (Figure 3-18).

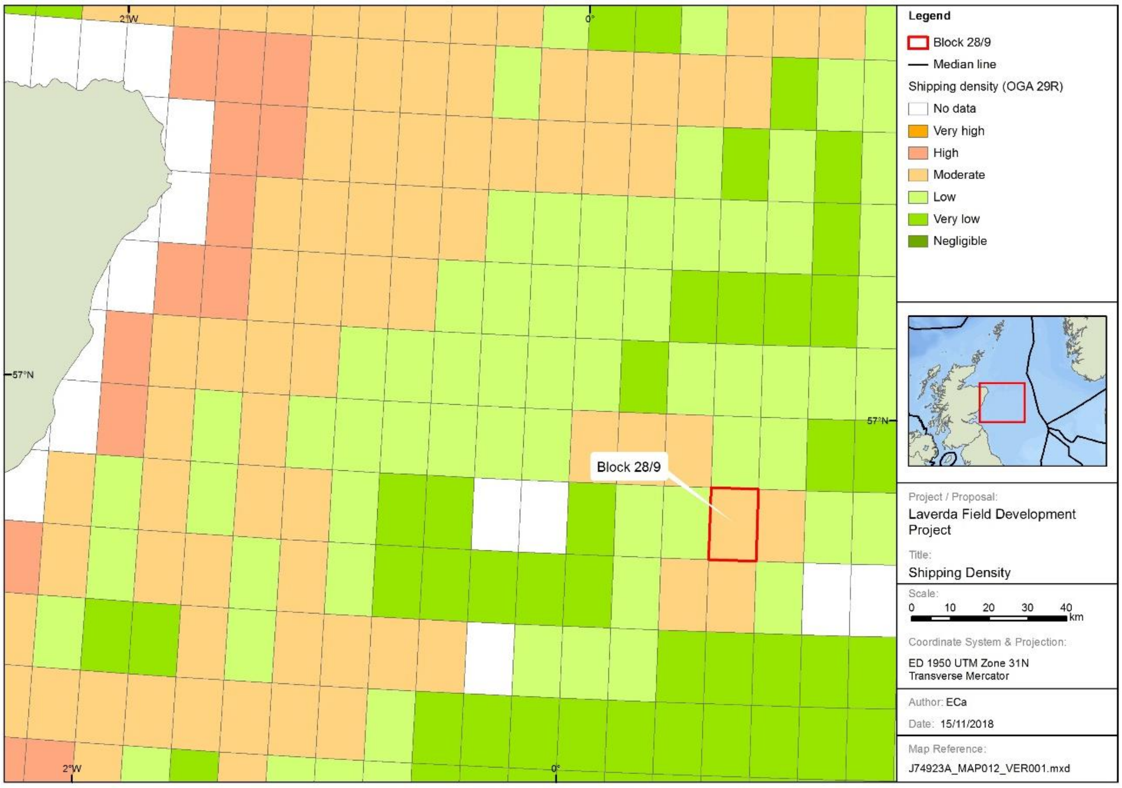



**Figure 3-18 Regional Shipping Density (DECC, 2014b)**

POUK commissioned Anatec to carry out a vessel traffic survey and collision risk assessment (Anatec, 2018). The shipping routes within 10 nm of the existing Catcher Development Area drill centres are shown in Figure 3-19. The results from the study concluded that the total operational collision risk for the nearby Varadero drill centre is 1 x $10^{-4}$ i.e. one collision per 9,700 years such that it can be considered to be low.

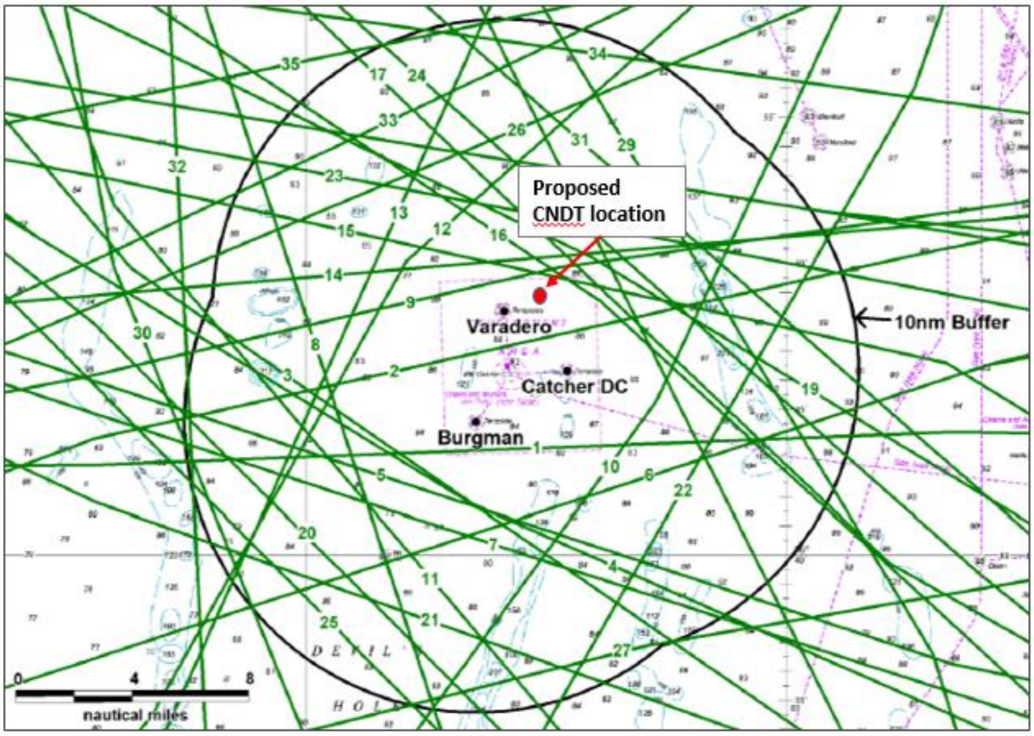



**Figure 3-19 Mean Shipping Route Positions within 10 nm of the Catcher Area Drill Centres.**

### 3.6.3 Surrounding Oil and Gas Infrastructure

The proposed Development is located to the west of a highly-developed oil and gas area in the Central North Sea (Figure 3-20). The closest surface installations to the proposed Development are identified in Table 3-11.

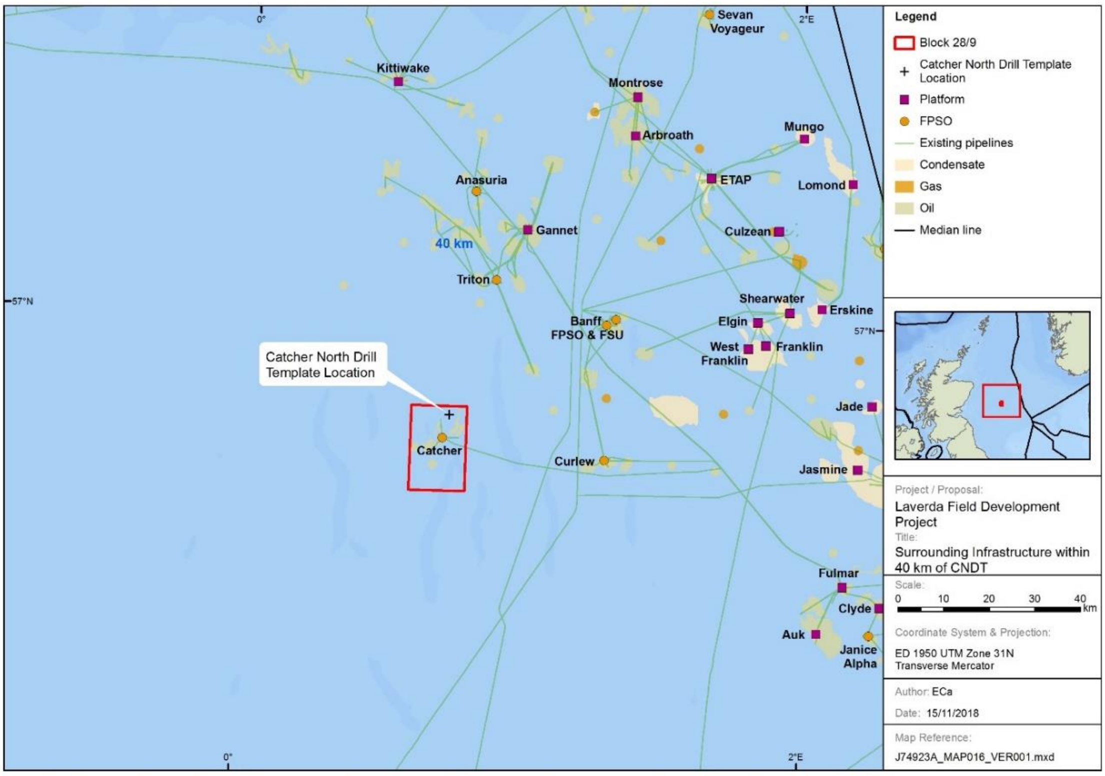



**Figure 3-20: Hydrocarbon Fields and Infrastructure within the Vicinity of the Laverda Field Development.**

**Table 3-11: Approximate Distances from the Proposed CNDT Location to Neighbouring Installations.**

| Installation | Approximate Distances |
|---|---|
| BW Catcher FPSO | 5.2 km south southwest |
| Triton FPSO | 31 km north northeast |
| Curlew FPSO | 35 km east southeast |
| Banff FSU & FPSO | 39 km northeast |
| Gannet A platform | 44 km north northeast |

### 3.6.4 Other Industries

There are no existing or planned renewable energy developments, or aggregate extraction licences, or submarine cables in the vicinity of the proposed Laverda Field Development.

### 3.6.5 Military Exercise Areas

There are no military exercise areas in the vicinity of the proposed Laverda Field Development.

### 3.6.6 Maritime Archaeology

Surveys undertaken for the Catcher Area Development, have identified three wrecks and one possible wreck in the area, the locations of which are shown in Figure 3-2. The nearest identified wreck to the proposed project is *c.* 4.4 km northwest of the proposed CNDT location. At this distance, none of the proposed activities will impact on the wrecks.

# 4 ENVIRONMENTAL ASSESSMENT METHODOLOGY

In order to determine the impact that the proposed Laverda Field Development may have on the environment, an EIA has been undertaken, following a structured methodology for the identification of environmental impacts. The approach is generally qualitative, although estimates of some quantitative data such as atmospheric emissions and area of disturbed seabed are also provided in Sections 5 to 11 which discuss the results of the EIA.

Implicit in the EIA is a clear and documented assessment of the impacts from each phase of the proposed project.

Potential effects are assessed in terms of:

- The duration of the activity (for planned events) or likelihood of occurrence (for unplanned events);
- The magnitude of the environmental impact; and
- The overall environmental risk (low, medium or high).

Impacts assessed as having a high or medium risk were considered further in order to identify additional mitigation and/or control measures. Standard industry recognised mitigation measures are assumed when assessing the magnitude of the planned events e.g. assumed that vessels comply with MARPOL. If required further

## 4.1 Planned Events

This section describes the risk matrix used to determine the impact to the environment of the planned activities associated with the proposed project.

### 4.1.1 Duration of Planned Activity

The planned activities are given a duration value according to the extent of the activity as shown in Table 4-1.

**Table 4-1 Duration of an Impact.**

| Planned activity duration | Duration category |
|---|---|
| One year to many years | 5 |
| One month to a year | 4 |
| One week to a month | 3 |
| One day to a week | 2 |
| Less than a day | 1 |

### 4.1.2 Magnitude of Planned Activity

As shown in Table 4-2, the magnitude of each potential environmental effect is also rated on a scale of 1 to 5, five being the most severe. Where magnitude appears to fall within two categories, the higher category is selected to provide a worst case scenario for the purposes of the assessment.

**Table 4-2 Definition of Magnitude of Environmental Effects.**

| Level | Definition |
|---|---|
| Severe (5) | • ***Emissions to air:*** Very large proportion (>5%) of total UKCS emissions.<br>• ***Discharges to water column and/or sediments:*** resulting in a recovery time > 5 years.<br>• ***Seabed disturbance*****:** Change in ecosystem leading to damage resulting in a recovery time > 5 years.<br>• ***Noise*****:** Potential for mortality or for injury within sensitive areas e.g. on a migration route or in area containing resident population.<br>• ***Waste*****:** Significant contribution to waste and special waste volumes.<br>• ***Socio-economic:*** Long term measurable or discernible degradation in socio-economic resources beyond the site boundary.<br>• Adverse effect on internationally or nationally protected populations, habitats or sites. |
| Major (4) | • ***Emissions to air*****:** Large proportion (2-5 %) of total UKCS emissions.<br>• ***Discharges to water column and/or sediments:*** resulting in a recovery period of 1-5 years.<br>• ***Seabed disturbance:*** Change in ecosystem leading to damage resulting in a recovery period of 1-5 years.<br>• ***Noise*****:** Potential for injury from noise (permanent threshold shift).<br>• ***Waste*****:** Significant contribution to waste volumes and small amounts of special waste.<br>• ***Socio-economic:*** Medium term measurable or discernible degradation in socio-economic resources beyond the site boundary.<br>• Adverse effect on regional or locally protected populations, habitats or sites. |
| Moderate (3) | • ***Emissions to air*****:** Moderate proportion (1-2 %) of total UKCS emissions.<br>• ***Discharges to water column and/or sediments:*** resulting in short term damage and a recovery period of <1 year.<br>• ***Seabed disturbance****:* Change in ecosystem leading to some damage with likelihood for recovery within 1 year.<br>• ***Noise****:* Potential for disturbance from noise (temporary threshold shift).<br>• ***Waste*****:** Small amounts of waste and special waste that can be recycled.<br>• ***Socio-economic:*** Short term measurable or discernible degradation in the socio-economic resources beyond the site boundary.<br>• Short term impacts on local protected populations, habitats or sites. |
| Minor (2) | • ***Emissions to air***: Small contribution (0.1 – 1%) to UKCS emissions.<br>• ***Discharges to water column and/or sediments*****:** Change is within scope of existing variability but potentially detectable.<br>• ***Seabed disturbance:*** Change to the quality or availability of habitats are short term and within the scope of variability.<br>• ***Noise*****:** Sound levels typical of the area.<br>• ***Waste*****:** Small contribution to waste volumes, no special waste.<br>• ***Socio-economic:*** Temporary measurable or discernible degradation in socio-economic resources at the local, regional and national level beyond the site boundary.<br>• Effect considered a nuisance. |

| Level | Definition |
|---|---|
| Negligible (1) | • ***Emissions to air:*** Negligible proportion (<0.1%) of total UKCS emissions.<br>• ***Discharges to water column and/or sediments:*** Effects are unlikely to be noticed or measured.<br>• ***Seabed disturbance*****:** Effects unlikely to be noticed or measured.<br>• ***Noise*****:** Sound levels within ambient levels.<br>• ***Waste:*** No significant contribution to waste volumes, no special waste.<br>• ***Socio-economic:*** Degradation in socio-economic resources is unlikely to be noticed beyond the site boundary.<br>• No measurable impact. |

### 4.1.3 Combining Duration and Magnitude to Establish Environmental Impact

The overall significance of the environmental impact of each activity associated with the proposed Development was assessed using a combination of the duration and magnitude scores as shown in Table 4-3.

**Table 4-3 Matrix Showing Significance of Environmental Impact.**

| | | Magnitude of Effect | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| **Duration of Occurance** | 5 | High | High | Medium | Medium | Low |
| | 4 | High | High | Medium | Medium | Low |
| | 3 | High | High | Medium | Low | Low |
| | 2 | High | High | Medium | Low | Low |
| | 1 | High | Medium | Low | Low | Low |

This process was undertaken for all identified aspects with the results presented in Appendix B. Those aspects identified as a possible moderate or high risk are discussed further in Sections 5-12.

## 4.2 Unplanned (Accidental) Events

This section describes the unplanned (accidental) risk matrix used to identify the potential risk of any unplanned events, resulting in the uncontrolled discharge of chemicals or hydrocarbons.

### 4.2.1 Likelihood of an Unplanned Event

Accidental events are given a likelihood value according to the likelihood of the unplanned event occurring as in Table 4-4.

**Table 4-4 Likelihood of an Unplanned Event.**

| Likelihood of accidental event | Likelihood category |
|---|---|
| Likely: More than once a year | 5 |
| Possible: Less than once per year and more than once every 10 years | 4 |
| Unlikely: Less than once every 10 years and more than once every 100 years | 3 |
| Remote: Less than once every 100 years and more than once every 1,000 years | 2 |
| Rarely: Less than once every 1,000 years and more than once every 10,000 years | 1 |

### 4.2.2 Magnitude of an Unplanned Event

The magnitude of the potential environmental effect of an accidental discharge is shown in Table 4-5. Where magnitude appears to fall within two categories, the higher category is selected to provide a worst case scenario for the purposes of the assessment.

**Table 4-5 Definition of Magnitude of Environmental Effects of an Unplanned Event.**

| Level | Definition |
|---|---|
| Extensive (5) | Very large oil or chemical pollution incident, national / international counter-pollution required, pollution may cross median line, may beach nationally or internationally.<br><br>Adverse effect on internationally or nationally protected populations, habitats or sites. Long term damage (>10 year recovery), measurable / discernible degradation in the quality or availability of habitats and/or social economic resources at the local, regional and national level beyond the site boundary.<br><br>Repeated incidents or repeated legal non-compliance: ongoing or multiple breaches of permit or licence conditions, and company policy. Prosecution by HSE or BEIS. |
| Major (4) | Very large pollution incidents, national/international counter-pollution required; pollution will/may cross median line, may beach nationally or will not beach internationally.<br><br>Adverse effect on regional or locally protected populations, habitats or sites. Medium term damage (5-10 years recovery) measurable / discernible degradation in the quality or availability of habitats or social economic resources at the local, regional, and national level beyond the site boundary.<br><br>Repeated incidents or repeated legal non-compliance: ongoing or multiple breaches of permit or licence conditions, and company policy. HSE or BEIS issue prohibition notice or revoke permit. |
| Significant (3) | Large pollution incident, counter pollution resources from national or regional centre; pollution may beach nationally, may cross median line, will not beach internationally.<br><br>Short term damage (2-5 years recovery) or measurable / discernible degradation in the quality or availability of habitats or social economic resources at the local, regional, national level beyond the site boundary.<br><br>Incident or legal non-compliance: major breach of permit or licence conditions, and company policy. HSE or BEIS issue enforcement notice. |
| Minor (2) | Pollution incident, counter pollution resources from regional centre; pollution will not beach.<br><br>Short term damage (<2 years recovery) or measurable / discernible degradation in the quality or availability of habitats or social economic resources at the local, regional, national level beyond the site boundary. Effect considered a nuisance.<br><br>Incident or legal non-compliance: breach of permit or licence conditions, and company policy. HSE or BEIS issue enforcement letter. |
| Slight (1) | Oil or chemical pollution incident can be managed by local resources; pollution will not beach.<br><br>Temporary damage (<1 year recovery) or measurable / discernible degradation in the quality or availability of habitats or social economic resources at the local, regional, national level beyond the site boundary. Effect considered a nuisance.<br><br>Incident or legal non-compliance: breach of permit or licence conditions dealt with via BEIS Non Conformance Report. |

### 4.2.3 Combining Likelihood and Magnitude to Establish Environmental Risk of an Unplanned Event

The overall environmental risk of an unplanned event was assessed using the combination of the magnitude and duration/likelihood scores as shown in Table 4-6.

**Table 4-6 Environmental Risk Classification Matrix for Accidental Discharges.**

| | | Magnitude of Effect | | | | |
|---|---|---|---|---|---|---|
| | | 5 | 4 | 3 | 2 | 1 |
| Likelihood of Occurrence | 5 | High | High | High | High | Medium |
| | 4 | High | High | High | High | Medium |
| | 3 | High | High | High | Medium | Low |
| | 2 | High | High | Medium | Low | Low |
| | 1 | High | Medium | Low | Low | Low |

# 5 PHYSICAL PRESENCE

This section discusses the potential impacts associated with the physical presence of:

- The vessels and HDJU drilling rig associated with the proposed Laverda Field Development; and
- All subsea infrastructure including stabilisation and protection materials.

on other sea users and animals (other than the benthic species), using the risk assessment methodology presented in Section 4. The impacts on the seabed and the local benthic communities are discussed in Section 8 'Seabed Disturbance'.

## 5.1 Presence of Vessels and the HDJU Drilling Rig

Vessels associated with the installation and commissioning phases of the proposed subsea tie-back development are expected to include tugs, construction vessels, rock cover vessel, DSVs, ERRV and the HDJU drilling rig (see Tables 2-8 and 2-10). The physical presence of the vessels and the HDJU drilling rig could potentially result in navigational hazards, a restriction of fishing operations, and short-term disturbance to marine mammals and seabirds.

During routine production operations (after drilling, installation and commissioning activities), the number of vessels present in the Catcher Development Area, will not significantly increase as a result of the proposed Laverda tie-back.

### 5.1.1 Impact of Vessels and Drilling Rig on Other Sea Users

An increase in the number of vessels in the area, will result in an increased risk of collision. A vessel traffic survey (Anatec, 2018) found that 29 shipping routes passed within 10 nm of the nearby Varadero drill centre. As discussed in Section 3.6.2, the results from the collision risk assessment (Anatec, 2018) suggest that the total operational collision risk is remote, at one collision per 9,700 years.

To minimise navigation hazards, all vessels engaged in the project operations will have markings and lightings as per the International Regulations for the Prevention of Collisions at Sea (COLREGS) (International Maritime Organisation (IMO), 1972) and vessel use will be optimised, where possible.

The HDJU drilling rig will be equipped with marine navigational aids and an aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations (Health and Safety Executive (HSE), 2009), to warn ships and aircraft of their position. In addition, it will be located within a 500 m exclusion zone which will mitigate collision risk and an ERRV will patrol the area.

As required by HSE Operations Notice 6 (HSE, 2014), a rig warning communication will be issued at least 48 hours before any rig movement. Notice of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the HDJU drilling rig, will be sent to the Northern Lighthouse Board (NLB). The drilling rig routes will be selected in consultation with other users of the sea, with the aim of minimising interference to other vessels and the risk of collision. In addition, prior to commencement of offshore activities, a CtL permit application will be submitted to BEIS.

The Laverda well and associated Catcher North/Laverda infrastructure will be located within ICES rectangle 42F0. The information presented in Section 3.6.1 suggests that fishing effort within this rectangle is relatively low. POUK have been in consultation with SFF regarding the proposed project (see Table 1-3) and will continue to consult with the SFF throughout the project, to discuss any potential concerns from the fishing industry.

As the proposed development is located in close proximity to a well-developed oil and gas area, the increase in vessel traffic is not anticipated to result in a significant change to existing levels.

Given the application of the mitigation measures identified in Section 5.5 and the relatively low levels of shipping and fishing activity in the area, the magnitude of the socio-economic effect of the additional vessels is considered to be negligible, whilst the significance of the environmental impact is considered **Low**.

### 5.1.2 Impact of Vessels and Drilling Rig on Marine Mammals

Note the impact of underwater noise associated with vessels and drilling activities, is discussed in Section 9. This section discusses the physical presence of the vessel and HDJU drilling rig. From Section 3.4.5, it can be seen that a number of marine mammals occur in the area which could be disturbed by the increase in vessel traffic. In addition, there could be an increased risk of injury to marine mammals through vessel strikes.

As the proposed project is within a well-developed oil and gas area, it is likely that marine mammals have been habituated to vessel activity in the area. In addition, the evidence for lethal injury from boat collisions with marine mammals, suggests that collisions with vessels are very rare (Cetacean Stranding Investigation Programme (CSIP), 2011). Out of 478 post mortem examinations of harbour porpoise in the UK carried out between 2005 and 2010, only four (0.8 %) were attributed to boat collisions.

Marine mammals may be attracted to installations (including the HDJU drilling rig) due to increased prey abundance (Todd *et al*. 2009); however, no evidence of impacts of installations on marine mammals on the UKCS have been reported.

Results from tagging studies, indicate that harbour seals do not occur in the area of the proposed Development, and only relatively low densities of grey seals are likely to occur (Section 3.4.5).

It is likely that the noise generated by the vessels will deter marine mammals from the immediate vicinity. Therefore, collisions with vessels are unlikely such that the magnitude of the effect associated with potential marine mammal and vessel collisions is considered to be negligible, whilst the significance of the environmental impact is considered low.

Marine mammals are anticipated to quickly adapt to the presence of the HDJU drilling rig, which will occupy a very small proportion of their overall available habitat. The magnitude of the environmental impact of the presence of the HDJU drilling rig is therefore considered to be negligible, whilst the significance of the environmental impact is considered **Low**.

### 5.1.3 Impact of Vessels and Drilling Rig on Birds

As described in Section 3.4.3, a number of bird species are found in the Laverda Field Development area. Many of these birds will travel to the area from the SPAs that are found along the UK coastal regions (see Figure 3-15).

The vessels and HDJU drilling rig have the potential to cause displacement of seabirds from foraging habitat and may cause flying birds to detour from their flight routes. For example, auk species (e.g. guillemot, little auk) are believed to avoid vessels by up to 200 to 300 m, but gull species (e.g. kittiwake, herring gull and great black-backed gull) are attracted to the presence of them (Furness and Wade, 2012). Seabird densities in the North Sea are reported to be seven times greater within 500 m of a platform. Lights are known to attract seabirds, however, increased food availability at the installation and the availability of roost sites may also be a factor (Weise *et al*. 2001).

Though evidence suggests that the presence of the vessels and the HDJU drilling rig could cause some bird species to be displaced from their foraging area, the very small proportion of their overall available habitat that will be occupied by the vessels and HDJU drilling rig, means the impact is not considered to be noticeable. In addition, given the existing oil and gas vessel activity in the area and the relatively close proximity to the BW Catcher FPSO, it is anticipated that the impact of the vessels and HDJU drilling rig on bird migration routes is not expected to be significant. Therefore, the magnitude of the environmental impact of the presence of the vessels and HDJU drilling rig on birds is considered to be negligible, whilst the significance of the environmental impact is considered **Low**.

## 5.2 Presence of Subsea Infrastructure

All subsea infrastructure including the drilling template, wellheads, flowlines, EHC umbilical, spools, jumpers, rock berm, mattresses and grout bags have the potential to impact on navigation, fishing operations and wildlife as a result of their physical presence.

### 5.2.1 Impact of Subsea Infrastructure on Other Sea Users

Demersal fish species make up a large portion of the fish caught in ICES rectangle 42F0 (see Section 3.6.1). Many of the fishing gears used to catch these species are towed along the seabed such that they may impact on any subsea structures that they come into contact with.

As discussed in Section 2.3.3, the option to protect the flowlines and EHC umbilical with rock cover was selected as the preferred option. POUK is committed to ongoing consultation with SFF, regarding the proposed rock composition and profiles. During early consultation, SFF expressed their preference for a single rock berm and if two rock berms are required, that they are separated by a minimum 50 m.

The Project will apply for a PWA (including a Deposit of Materials Consent) and will comply with PWA notification requirements. In addition, a CtL application will be submitted to BEIS including the results of vessel traffic surveys.

The CNDT will be “fishing friendly” i.e. non-snaggable (but not over-trawlable) such that it will allow removal of snagged fishing gear, by simple reversal or ‘backing-up’ of the fishing gear. In addition, the CNDT will be located within a 500 m exclusion zone, whilst all mattresses and grout bags will also be laid within 500 m zones, either at the CNDT or at the Varadero manifold.

Given that fishing activity in the area is considered relatively low, the rock berms will be designed such that their profiles align with SFF preferences. Furthermore, the mattresses, grout bags and CNDT will be located within 500 m exclusion zones, and the mitigation measures identified in Section 5.5 will be adhered to. As a result, the magnitude of the effect on fishing activities in the area is considered minor, whilst the significance of the impact is considered **Medium**.

### 5.2.2 Impact of Subsea Infrastructure on Marine Mammals and Fish

Marine mammals and fish in the area are anticipated to adapt to the presence of the subsea infrastructure, which will occupy a very small proportion of their overall available habitat. The magnitude of the effect on marine mammals and fish is considered negligible and the significance impact is considered **Low**.

Note, the impact on the benthic communities is discussed separately in Section 8 'Seabed Disturbance'.

## 5.3 Decommissioning Phase

At Cessation of Production (CoP), the Laverda and Catcher North infrastructure will be decommissioned as part of a Decommissioning Programme incorporating the Catcher Area Development. The wells and subsea facilities will be decommissioned in accordance with guidelines, standards and regulations applicable at that time. At the commencement of the decommissioning activities, vessel activity in the area will increase relative to the number of vessels typically present in the area of the development, during the production phase. The majority of the decommissioning activities will occur within existing 500 m exclusion zones, such that they are not expected to significantly impact shipping and fishing activities in the area at the time.

In line with current BEIS Guidance (BEIS, 2018), a Comparative Assessment will be carried out to determine the optimal approach for decommissioning the flowlines and EHC umbilical. At the time of writing, it is expected that the CNDT, the Laverda Xmas tree, spools, EHC jumper, mattresses and grout bags will be removed unless the comparative assessment of the safety, environmental, technical, societal and economic impacts indicates that leaving wholly or partially in situ is the best practicable option.

Following decommissioning, over trawl trials or surveys (e.g. side scan sonar) will be carried out, along the flowline and umbilical route and within the CNDT 500 m exclusion zone, to ensure a clear seabed. Following decommissioning, POUK will surrender the 500 m exclusion zone at the CNDT.

## 5.4 Cumulative and Transboundary Effects

The proposed Laverda Field Development activities will result in a modest increase in activity as a result of additional vessel movements. Given that these activities will occur within a well-established area for oil and gas activity and will be short term in nature, significant cumulative impacts are not expected.

The proposed Laverda Field Development will be located *c.* 104 km from the UK/Norwegian median line and therefore no transboundary impacts associated with the physical presence of the HDJU drilling rig, or vessels, are expected.

## 5.5 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with the physical presence of the vessels, HDJU drilling rig and infrastructure associated with the proposed Laverda Field Development.

**Proposed Mitigation Measures**

- Ongoing consultation with SFF;
- Notice to Mariners will be circulated prior to rig mobilisation;
- Notice will be sent to the NLB of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the HDJU drilling rig;
- The HDJU drilling rig will abide by CtL conditions;
- A Collision Risk Management Plan will be produced;
- All vessels will adhere to COLREGS and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.;
- The HDJU drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations;
- Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site;
- Flowlines will be designed in accordance with industry standards;
- A 500 m exclusion zone will be applied for at the CNDT location;
- The use of pipeline stabilisation features (e.g. mattresses, rock cover and grout bags) will be minimised through project design and will be used in accordance with SFF preferred practice.
- Size of rock and rock cover profiles will be in accordance with industry best practices.

Applying the impact assessment methodology described in Section 4 and the mitigation measures listed above, the impact significance of the presence of the vessels, and the HDJU drilling rig on other sea users, marine mammals, fish and birds is considered **Low**. Similarly, the impact significance of the subsea infrastructure on marine mammals and fish is considered **Low**. The magnitude of effect of the subsea infrastructure on other sea users is considered slight, whilst the significance of impact is considered **Medium**.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix A.

# 6 EMISSIONS TO AIR

Gaseous emissions can contribute to global atmospheric concentrations of greenhouse gases, regional acid loads, poor air quality and ozone depletion with the main pollutants of concern being carbon dioxide ($CO_2$), oxides of nitrogen (NOx), sulphur dioxide ($SO_2$), methane ($CH_4$) and volatile organic compounds (VOCs). These pollutants, associated with fuel use, will all be produced during the drilling, installation, commissioning and operational phases of the proposed Laverda Field Development. This section describes and quantifies the sources of emissions during each phase of the proposed development. Using the risk assessment methodology presented in Section 4, the significance of the environmental impact of the anticipated project emissions is determined.

## 6.1 Drilling Phase

### 6.1.1 Exhaust Emissions from the HDJU Drilling Rig and Support Vessels

This section discusses the potential environmental impacts associated with emissions from the HDJU drilling rig and support vessels.

Table 2-8 presents the anticipated maximum number of days that the HDJU drilling rig and supporting vessels will be on location when drilling the Laverda well. Table 6-1 summarises the predicted emissions from the HDJU drilling rig. It can be seen from the table that the emissions from diesel use by the drilling rig represent *c*. 0.26 % of the $CO_2$ emissions associated with diesel use by drill ships, semi-submersibles and HDJU drilling rigs in 2015. Relative to other UKCS emissions associated with drill rigs, the magnitude of the environmental impact associated with these emissions is considered to be minor and the significance of the environmental impact is considered **Medium**.

**Table 6-1: Estimated Emissions Associated with Diesel Consumption of HDJU Drilling Rig.**

| | Total Fuel Use (Te) | Te | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $CO_2$ | $NO_x$ | $N_2O$ | $SO_2$ | CO | $CH_4$ | VOC |
| Emissions associated with the HDJU drilling rig (estimated at 75 days) | 540 | 1,728 | 32 | 0.1 | 2.2 | 8.5 | 0.1 | 1.1 |
| Emissions from diesel use on drill ships, semi-submersibles and HDJU on the UKCS in 2015[1] | | 656,181 | | | | | | |
| Rig emissions as a % of the 2015 total | | 0.26 | | | | | | |
| [1]EEMS data 2015. | | | | | | | | |

Table 2-8 summarises the fuel use associated with the drilling support vessels, whilst Table 6-2 provides an estimate of the associated emissions. It can be seen from Table 6-2 that emissions from diesel use by the drilling support vessels represents approximately 0.04 % of the $CO_2$ emissions associated with domestic and international shipping in 2014. Relative to other UKCS emissions the magnitude of the environmental impact associated with these emissions is therefore considered negligible and the significance of the environmental impact is considered **Low**.

**Table 6-2: Estimated Emissions Associated with the Drilling Support Vessels.**

| | Total fuel use (Te) | Te | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $CO_2$ | $NO_x$ | $N_2O$ | $SO_2$ | CO | $CH_4$ | VOC |
| Total emissions associated with drilling support vessels | 1,122.5 | 3,592 | 67 | 0.25 | 4.5 | 17.6 | 0.2 | 2.25 |
| Approximate shipping emissions in UK waters (domestic and international) 2014[1] | | 9,900,000 | - | - | - | - | - | - |
| Annual emissions from drilling support vessels as a % of shipping emissions in UK waters | | 0.04 | - | - | - | - | - | - |
| [1]Committee on Climate Change (2015) | | | | | | | | |

### 6.1.2 Well Clean-Up and Testing

The duration of the well clean-up and test in combination will be less than 96 hours, with estimated emissions 1,996 te oil flared and 106 te gas flared. Table 6-3 summarises the total emissions associated with the well clean-up, calculated using emission factors from the EEMS Atmospherics Calculations (EEMS, 2008). An oil discharge permit will be requested for the discharge of hydrocarbons in the produced water, following well clean-up and testing.

**Table 6-3: Anticipated Emissions Associated with the Well Clean-Up and Testing of the CTP1 Well**

| Source | Duration | Total fuel use | Emissions (te)[1] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | $CO_2$ | $NO_x$ | $N_2O$ | $SO_2$ | CO | $CH_4$ | VOC |
| Well clean-up | <96 hours | 1,996 te oil 106 te gas | 6,684 | 7.51 | 0.17 | 0.03 | 36.64 | 54.67 | 50.43 |
| UKCS flaring emissions 2012 | | | 2,891,923 | | | | | | |
| Total emissions as a % of total UK 2012 | | | 0.23 | | | | | | |
| *[1] EEMS, 2008* | | | | | | | | | |

The total $CO_2$ emissions associated with well clean-up and testing flaring amounts to *c*. 0.23 % of the total UKCS emissions (2012). Relative to other UKCS emissions, the magnitude of the environmental impact associated with these emissions is therefore considered minor and the significance of the environmental impact is considered **Low**.

## 6.2 Installation and Commissioning Phase

Table 2-10 describes the vessels required for the installation of the subsea infrastructure associated with the proposed Development. It can be seen from Table 6-4 that emissions from diesel use by the drilling support vessels represents approximately 0.03 % of the $CO_2$ emissions associated with domestic and international shipping in 2014. Relative to other UKCS emissions, the magnitude of the environmental impact associated with these emissions is therefore considered negligible and the significance of the environmental impact is considered **Low**.

**Table 6-4: Estimated Vessel Emissions Associated with the Subsea Installation and Commissioning Activities.**

| | Total fuel use (te) | Te | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $CO_2$ | $NO_x$ | $N_2O$ | $SO_2$ | CO | $CH_4$ | VOC |
| Subsea installation vessels | 843 | 2,698 | 50 | 0.19 | 3.4 | 13.2 | 0.15 | 1.7 |
| Shipping emissions in UK waters (domestic and international) 2014[1] | | 9,900,000 | - | - | - | - | - | - |
| Installation support vessel emissions as a % of shipping emissions in UK waters | | 0.03 | - | - | - | - | - | - |

[1] Committee on Climate Change (2015)

## 6.3 Production Phase

Emissions from the production phase can primarily be divided into emissions associated with power generation, flaring and direct emissions (including gas venting, emissions from during offloading etc.). The incremental production from the Laverda tie-back will not require any changes to the power generation equipment, flaring or venting systems on the BW Catcher FPSO.

POUK/ BWOCUK have operational experience of bringing new wells online into the BW Catcher FPSO where no routine operational flaring is planned. This is achieved by design, as excess HP gas is exported via the Fulmar gas line and a Vapour Recovery Unit minimises the LP flare. As a result, it is anticipated that production start-up from the Laverda Field will be manageable and result in no incremental operational flaring.

Whilst no significant changes to the BW Catcher FPSO's fuel forecast are expected, the existing BW Catcher FPSO Combustion Installations Permit (PPC) will be reviewed and any changes as a result of the Laverda tie-back will be detailed in a permit variation.

During production, emissions at the BW Catcher FPSO will not differ significantly from current levels following tie-back of the proposed Laverda Field Development and therefore they are not considered further here.

## 6.4 Decommissioning Phase

Decommissioning activities at the end of Field Life will require an increase in vessel numbers relative to those present during the production phase. A HDJU drilling rig will be brought on site to plug and permanently abandon the well in accordance with OGUK Guidelines for the Abandonment of Wells (OGUK, 2015) (or applicable guidance at that time).

In addition, vessels will be involved in recovery activities associated with the wellhead, Xmas tree, tie-in jumpers etc.

At the time of decommissioning, POUK may carry out an energy balance assessment based on the Institute of Petroleum 'Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures' (Institute of Petroleum, 2000) (or applicable guidance at the time). The assessment will include identification of all end points associated with decommissioning each structure, including the presence of material in landfill sites, or on the seabed. For each end point, energy use and atmospheric emissions resulting from vessels, onshore transport to smelting yards, smelting activities etc., will be assessed and their environmental impacts determined. Emissions associated with decommissioning activities are not assessed further at this time.

## 6.5 Cumulative and Transboundary Effects

It is not expected that emissions from the drilling and installation activities will have a significant detrimental impact on air quality in the vicinity of the installation. Similarly, given the distance (*c*. 104 km) from the UK / Norwegian median line, no transboundary impacts associated with the emissions are expected.

## 6.6 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with emissions to air resulting from the proposed Laverda Field Development.

**Proposed Mitigation Measures**

- The HDJU drilling rig will be subject to audits ensuring compliance with UK legislation;
- The impact from vessel emissions will be mitigated by optimising support vessel efficiency and minimising duration of activity;
- During drilling there will be adherence to good operating practices and maintenance programmes;

Emissions from combustion equipment are regulated through EU ETS and PPC Regulations. As part of the PPC permit the following measures will be in place:

- During production there will be adherence to good operating practices, maintenance programmes;
- The emissions from the combustion equipment will be monitored;
- Plant and equipment will be subject to an inspection and energy maintenance strategy;
- UK and EU air quality standards are not exceeded;
- Fuel gas usage will be monitored; and
- Energy assessments will be carried out as required.

Applying the impact assessment methodology described in Section 4 and taking account of the mitigation measures listed above, the impact significance of the atmospheric emissions associated with vessel use (other than the HDJU drilling rig) is considered **Low**. When the emissions associated with the HDJU drilling rig are compared with those from drill ships, semi-submersibles and HDJU on the UKCS, the impact significance is considered **Medium**.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix A.

# 7 DISCHARGES TO SEA

This section assesses the planned and permitted marine discharges from the proposed Laverda Field Development Project, using the assessment methodology presented in Section 4 and discusses the management and mitigation measures employed in order to adhere to legislation and to minimise environmental impact. All phases will involve the discharge of sewage and food waste from vessels; however, these discharges will be in line with MARPOL requirements and the environmental risks are considered negligible. They are therefore not assessed further.

## 7.1 Drilling Phase

Planned and permitted discharges to sea during drilling operations include drill cuttings, associated fluids (WBM including seawater and viscous bentonite sweeps), cement and associated chemicals. As discussed in Section 2.5.4 the LTOBM contaminated cuttings will be skipped and shipped to shore for treatment and subsequent disposal.

### 7.1.1 Discharge of Drilling Fluids and Drill Cuttings

The drill cuttings and associated seawater and bentonite sweeps from the 36" and 26" sections of the proposed Laverda well will be discharged *c*. 1 m above the seabed. The volume of cuttings associated with these sections has been estimated at *c*. 385 te (Table 2-6). It is expected that in the immediate vicinity of the well, the cuttings will accumulate in a cuttings pile. As the Catcher North well will be drilled at the same drilling template as the Laverda well, the cuttings from both wells will impact on much of the same area. Therefore, to address cumulative impacts, the discharged cuttings from the Catcher North well are also considered here and are assumed to be of similar volume to those of the Laverda well[1].

In order to describe the potential impact of the discharged cuttings from the Laverda and Catcher North wells, reference has been made to the modelling carried out in support of the Catcher, Varadero and Burgman Environmental Statement (Premier 2013). This modelling was based on the drilling of 23 wells across six drilling templates and modelled the discharge of 549 te of cuttings from each well directly to the seabed. Given the close proximity of the CNDT location to the Catcher, Varadero and Burgman wells, the cuttings from the Laverda and Catcher North wells will be under the influence of similar currents. Also, the area impacted by the cuttings from these two wells will be less than that modelled at the other locations, as the total weight of cuttings to be discharged is less.

The dispersal and deposition of drilling mud and cuttings at the Catcher, Varadero and Burgman wells was modelled using the DREAM (Dose-related Risk and Effect Assessment Model) (Sintef, part of the Marine Environmental Modelling Workbench (MEMW) suite of models) which incorporates the ParTrack sub-model, used for modelling the dispersion and settlement of solids. The model predicts the fate of materials discharged to the marine environment (their dispersion and physico-chemical composition over time) and it can also

[1] Note full details of the cuttings volumes associated with the Catcher North well will be detailed in the drilling permit applications to be submitted in advance of the execution phase.

calculate an estimate of risk to the environment, using a metric known as the Environmental Impact Factor (EIF).

The modelling found that the thickness of each cuttings pile at each field (comprising cuttings from 7 to 8 wells at each field) was found to fall off rapidly, such that it is less than 1 mm within 350 m. Figure 7-1 shows the resultant thickness of cuttings at the Catcher Field. The peak thickness of deposition is approximately 530 mm, though it is noted that since the model averages the thickness over the grid size, there may be local thicknesses greater than 530 mm very close to the release points. Thickness rapidly diminishes with distance; beyond 115 m of the Catcher drill centre, the maximum depositional thickness was predicted to fall below 30 mm. It is expected that this rapid decrease in sediment thickness will occur within a shorter distance at the CNDT location, given that only two wells will be drilled.

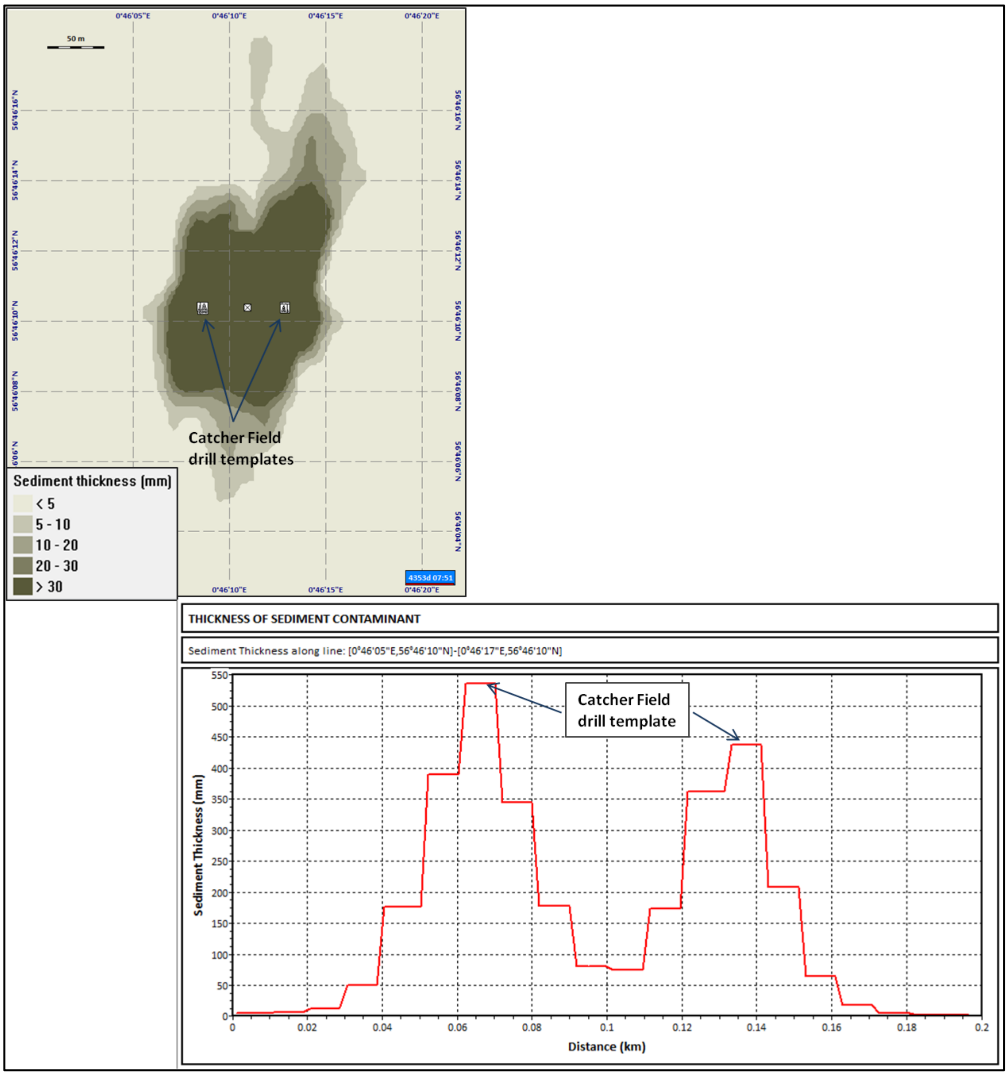



**Figure 7-1: Deposition Thickness and Cross Section Showing Thickness from East to West Through the Catcher Drill Site.**

The total risk to the seabed (calculated from the EIF), due to a combination of grain size change, burial thickness and pore-water oxygen depletion at cessation of drilling, was calculated for the Catcher, Varadero and Burgman Environmental Statement (Premier, 2013). The spatial extent over which the EIF exceeds 5 % is taken as a measure of overall risk to the environment and can be used as a measure of significance. In the Catcher, Varadero and Burgman scenario where, the discharge of cuttings from 7 to 8 wells at each field was accounted for, a risk to at least 5 % of the most sensitive species within the sediment was predicted to persist within a 0.15 $km^2$ area around the drill site for up to 2.5 years following the cessation of drilling. The main contributors to sediment risk were grain size change and burial thickness. After 2.5 years, the risk was found to fall off rapidly and was insignificant by 3 years.

Extrapolating from the results of the previous Catcher, Varadero and Burgman modelling, it is anticipated that drilling the Laverda and Catcher North wells will result in a much smaller seabed area over which the EIF exceeds 5 %. Furthermore, by the end of 2020, the total of 21 wells that will have been drilled across the Catcher area (including the Laverda and Catcher North wells) is within the assumptions used for the previous modelling. For example, the original plan was to drill 7 wells at the Varadero drill centre. To date POUK has drilled 4 wells at Varadero and plans to drill three more in 2020 (i.e. one more at the second Varadero drill template and the Laverda and Catcher North wells from the template located *c*. 2.4 km away from the Varadero drill centre. As a result, it is anticipated that any drill cuttings impacts associated with drilling these wells will be similar to that already predicted for seven Varadero wells.

Any suspended solids or entrained drilling fluids that do not quickly settle out of the water column will contribute to water column toxicity. This is particularly relevant to soluble drilling fluids forming part of the mud package. The modelling carried out to support the Catcher, Varadero and Burgman Environmental Statement (Premier, 2013) suggested that the water column risk extends to around 1 km in the direction of the plume during discharge from each well section and recovers within hours of the discharge. The primary contributors to this risk were bentonite and barite in the drilling mud, whose particle size and, in the case of barite, the angularity of particles, contribute to stress on zooplankton and filter feeders.

**Impacts Associated with the Discharge of Drill Cuttings**

Discharged cuttings will cause smothering of the benthic organisms in the immediate area of the release. Recovery of benthic communities from burial and organic enrichment occurs by recruitment of new colonists from planktonic larvae and immigration from adjacent undisturbed sediments. Ecological recovery usually begins shortly after completion of drilling and often is well advanced within a year. Full recovery may be delayed, until concentrations of biodegradable organic matter decrease through microbial biodegradation, to the point where surface layers of sediment are oxygenated (Neff, 2005). Gates and Jones (2012) found evidence of recovery when comparing results from a pre- drill survey and one carried out three years later. The authors noted that the visible extent of the cuttings pile had decreased over time and that, though megafauna had returned to the area, they were still present at a lower density to that found in the pre-drill surveys.

The majority of seabed species recorded from the European continental shelf are known or believed to have short life spans (a few years) and relatively high reproduction rates (Rees and Dare, 1993), indicating the potential for rapid population recovery. Therefore, it is expected that the benthic species will be recruited from the surrounding seabed and recovery from physical impacts will be relatively rapid.

Rye *et al*. (2006) considered the recovery of sediments impacted by drilling discharges and concluded that, while there is high variability between sites, it is reasonable to conclude that, in most cases, once any toxic effects have ceased, recovery to a productive ecosystem will take place within five years for WBM-cuttings discharges. A recent scientific review by IOGP concluded that the accumulation of water-based mud cuttings in sediments is usually minor and biological recovery is often well underway within a year of completion of discharge (IOGP, 2016).

No Annex I habitats, or benthic species that could potentially be impacted by discharged cuttings from the Laverda and Catcher North wells, were identified during the environmental baseline surveys across the Catcher Area Development area (Section 3.3.2). The closest potential MDAC site to the CNDT location lies approximately 4.4 km north -northeast of the proposed CNDT location (Figure 3-2). At this distance the identified potential MDAC sites will be unaffected by smothering from drill cuttings.

Where avoidance by fish is not possible, the sensitivity to suspended sediments varies greatly between species and their life history stages and depends on sediment composition (particle size and angularity), concentration and the duration of exposure (Newcombe and Jensen, 1996). Being the major organ for respiration and osmoregulation, gills are directly exposed to, and affected by, suspended solids in the water. If sediment particles are caught in or on the gills, gas exchange with the water may be reduced leading to oxygen deprivation (Essink 1999; Clarke and Wilber 2000). This effect is greatest for juvenile fish as they have a higher oxygen demand and small gills at higher risk of clogging (FeBEC 2010).

Block 28/09 has no periods of concern for drilling noted by JNCC. Coull *et al*. (1998) suggest that sandeels may spawn in the wider Catcher Area. Sandeels prefer to spawn in substrates with a low clay silt fraction. The seabed at the Catcher Area Development area is dominated by a fine veneer of Holocene silty sand with minor shell fragments and patchy areas of mixed and coarser sediments indicative of accumulations of shells and gravel (Premier, 2013). This would suggest that the area to be impacted by the drill cuttings is not a preferred sandeel spawning habitat.

The nearest wreck is *c*. 4.4 km north-northwest of the proposed CNDT location. At this distance none of the proposed activities will impact on the wrecks.

Given the nature and volume of the drilling muds and drill cuttings to be discharged, the comparatively small area of impact, the relatively rapid recovery rate of the water column and seabed and the absence of Annex I habitats or wrecks in the area of impact, the magnitude of the environmental effect of the discharge of cuttings is considered to be moderate, whilst the significance of the environmental impact is considered **Medium**.

### 7.1.2 Cement and Cementing Chemicals

As described in Section 2.1.1 when drilling a well, cement is used to secure the steel conductor and casings in the well bore, whilst cementing chemicals are used to modify the technical properties of the cement slurry. The discharges associated with these cementing operations are described briefly here, and will be detailed in the drilling permit applications submitted to BEIS, prior to the commencement of drilling. These include:

- Discharge of residual mixed cement from the rig following a cementing operation;
- Discharge of cement as a result of an aborted cementing job; and
- Discharge onto the seabed of excess cement pumped down the well.

**Residual Mixed Cement and Aborted Cement Jobs**

Prior to carrying out the cementing job, dry cement is mixed in a cement unit on board the drilling rig. Once the cement job is completed the cement unit is washed, to remove any residual chemical additives and/or cement slurry from the lines, as any cement slurry left in the lines will set and block the line rendering the cement unit incapable of performing the next job, until this blockage is removed. The water and residual cement are discharged overboard.

The need to abort a cement job may arise for a number of reasons, including a total failure of the pumping equipment, a blockage (either on surface or down the wellbore) in the pipes through which the cement is pumped, or due to changing downhole well conditions (i.e., wellbore collapse, losses, or well control scenarios). In these instances, the consequences of not discharging mixed cement would be severe, with the potential for cement to settle in the pumps, pits and lines on the rig, rendering the equipment unusable until the hardened cement is removed from surface equipment. This could in turn result in major workscopes associated with disconnecting, removing and cleaning the lines before reconnecting them, in order to return the equipment to operational status.

The cement discharges associated with the planned flushing operations of the cement unit or those associated with an aborted cement job, are expected to disperse rapidly in the upper water column. Using data from Stark and Mueller (2003), it is concluded that at North Sea temperatures, cement particles that have been diluted will not increase significantly in particle size due to their hydration reaction and will remain in the range 10-30 microns or smaller which is controlled by their manufacture and specification. Such particles will take many days to settle through the water column and will be in an inert reacted state once at the seabed, with negligible impact. The initial discharge may affect plankton in the localised area of the plume, with rapid recovery expected similar to a discharge of drilling solids.

Over a period of hours, it is expected that the cement discharged following the washing of the cement unit, or, as the result of an aborted cement job, will be indistinguishable from background suspended solids concentrations, such that the magnitude of the environmental effect is considered negligible, whilst the significance of the environmental impact is considered **Low.**

**Excess Cement Pumped Down the Well**

Once injected, it is anticipated that the majority of the cementing material will remain down hole, with discharge to the environment only occurring when the casings are cemented back to the seabed. Any cement returns will be discharged in the immediate vicinity of the wellhead and will likely impact on an area already impacted by the drill cuttings.

The cement mixture is designed to set rapidly, and the majority of the slurry will set into masses of inert solid cement, smothering a small area of seabed near to the casing, and ultimately will behave similarly to rocks of the same size. Discharges to the seabed are at a density of around 1.9 $t/m^3$ in a semi-cohesive state, and as mentioned, are expected to flow onto the area already disturbed by cuttings from drilling the tophole sections, with some dispersion into the water column.

Large cement deposits on the seabed are not expected. Should they occur, they will be addressed in the mandatory debris survey at the decommissioning stage, at the end of field life. It is not expected any deposits would be capable of posing a hazard to towed fishing gear in the area. However if any large deposits are identified during the decommissioning stage, relevant measures will be taken to mitigate any potential dangers in the area before the removal of the drill centre 500 m safety zone. Any increase in turbidity of the water column as a result of cement returns would be localised and short-lived.

## 7.2 Subsea Installation and Commissioning Phase

Depending on detailed design, it is possible that the pipeline testing and commissioning operations, would require a discharge to sea of the pipeline preservation fluids (Section 2.6.4).

These discharges could contain chemicals including oxygen scavengers and biocides to mitigate the risks of corrosion or bacterial growth, whilst an ultraviolet-fluorescent dye may be added to assist in leak detection.

POUK aims to minimise the effect of the chemicals used/discharged during its operations, and as such, wherever possible, chemicals will be chosen which are PLONOR or are of a Hazard Quotient (HQ) <1. All CHARMable chemicals discharged will be further assessed by calculating a RQ. Where chemical use and discharge results in a RQ value >1, thus indicating a possible risk of the discharge causing harm to the marine environment, further investigation of the product will be carried out, to determine if there is an alternative product that can be used which produces a lower RQ, or if the discharge can be diluted in order to reduce its RQ.

All chemicals used during pipeline testing and commissioning will be risk assessed within the Pipeline Operation MAT applications. The testing will be carried out over a short timescale and the amount of chemicals discharged to the marine environment will be minimised.

Marine flora and fauna may be affected on a localised level, but given POUK's commitment to prioritise the use of chemicals which are PLONOR, or are of a HQ <1, and the rapid dilution that will occur on discharge, the magnitude of the environmental effect is considered negligible, whilst the significance of the environmental impact is considered **Low.**

## 7.3 Production Phase

There will be some discharges to sea of cooling water and drainage water during the production phase, whilst the primary discharges will be associated with produced water.

Discharges of cooling water and drainage water, at the BW Catcher FPSO, are not anticipated to change as a result of the Laverda tie-in and are therefore not discussed further.

### 7.3.1 Produced Water Discharges

Formation water is naturally trapped in oil and gas reservoirs and, despite efforts to produce the hydrocarbons selectively, a fraction of this water is brought to the surface mixed with oil and gas. This PW may comprise dispersed oil, metals and organic compounds such as dissolved hydrocarbons, organic acids and phenols.

The PW treatment system on board the BW Catcher FPSO is designed to reach OiPW concentrations of 20 mg/l whilst the PWRI system is designed to enable up to 95 % of PW to be injected. Prior to injection, the PW is treated to keep the OiPW concentration in line with the BW Catcher Oil Discharge permit limit of < 20 mg/l.

Produced water from the Laverda Field is expected to peak in 2028 at a rate of 628 te/day (see Table 2-14).

**Oil Associated with Produced Water**

Table 7-1 provides estimated peak oil discharges at the BW Catcher FPSO. Based on an OiPW concentration of 20 mg/l, and a reinjection capacity of 95 %, the volume of oil associated with the discharge of 5 % of the maximum BW Catcher FPSO PW capacity (20,988 te/day) is estimated to be *c*. 7.8 te/year (0.021 te/day). This equates to *c*. 0.34 % of the UK total[2].

In the year of maximum PW production rates at Laverda (628 te/day: see Table 2-14) the discharged oil associated with Laverda produced water would comprise 2.99 % of the total discharges BW Catcher FPSO or *c*. 0.01 % of the UK total.

**Table 7-1: Estimated Peak Oil Discharges.**

| | Laverda peak water production (2025) | Maximum produced water capacity at the FPSO |
|---|---|---|
| Produced water | 628 te/day | 20,988 te/day |
| Maximum PW discharged (5 %) | 31.4 te/day | 1,049 te/day |
| Discharged OiPW assuming OiPW concentration of 20 mg/l | 0.23 te/year | 7.8 te/year |
| 2015 UK OiPW discharge total* | 2,283 te/yr | |
| % of UK total assuming OiPW concentration of 20 mg/l | 0.01 % | 0.34 % |
| * Source: DECC (2016) based on 92 installations discharging PW on the UKCS | | |

[2] According to DECC (2016) a total of 2,283 te of oil was discharged in PW from UK installations in 2015.

### Chemicals Associated with Produced Water

Chemical use and discharge during production is regulated under the Offshore Chemicals Regulations (OCR). Chemicals discharged into the marine environment have the potential for acute or long term effects on marine organisms. Whether these effects are realised depends on a number of factors such as the inherent toxicity of the product, the quantities discharged and resulting concentrations in the water column, the length of time biota are exposed to that concentration and the sensitivity of the organisms to the particular chemical. Chemicals discharged from offshore operations are immediately diluted in the sea. The amount of dilution depends on the water depth and water currents but is estimated to be a dilution of *c*. 1:1,000 at a distance of 500 m from the discharge point. This dilution tends to reduce concentrations to levels which are not acutely toxic to marine organisms (OGUK, 2016).

Details (e.g. type / volume) of all production chemicals are provided in the existing BW Catcher FPSO Production Operation MAT application. Chemicals to be used during the processing of the Laverda hydrocarbons have yet to be confirmed, though are expected to be similar to those currently used at the Laverda FPSO. Chemicals which are PLONOR or of lowest toxicity will be prioritised where technically feasible. Prior to coming on line, the proposed Laverda chemicals will be added to the BW Catcher FPSO chemical permit.

### Impacts Associated with Produced Water Discharges

The discharge of PW to sea is one of the largest discharges associated with offshore oil and gas developments. As discussed PW contains residues of reservoir hydrocarbons, as well as chemicals added during the production process and dissolved organic and inorganic compounds (metals) that were present in the geological formation.

Following its discharge to sea, PW undergoes several weathering processes, partly influenced by the behaviour of the discharge plume which may be dense and sink towards the seabed or buoyant and rise to the surface. The effluent dilutes rapidly upon discharge to well-mixed seawater. Low molecular weight organic compounds will either volatilise into the air or be degraded by micro-organisms present in seawater. Many constituents will precipitate on discharge (e.g. certain metals). Higher molecular weight organic particles adsorb onto suspended solids and sediment. Individually or collectively, these processes tend to reduce concentrations of PW compounds in the receiving environment and thereby decrease their potential toxicity and bioavailability to marine organisms (OGP, 2005).

Research into the effects of PW discharges has focused on components that could result in chronic biological effects, in particular Polycyclic Aromatic Hydrocarbons (PAHs) and high molecular weight phenols. PAHs are known to have mutagenic, carcinogenic and teratogenic properties. However, many marine organisms have the ability to metabolise and detoxify PAHs at the concentrations found in the receiving environment. In the laboratory, high molecular weight phenols can be shown to exhibit endocrine disruption (Bakke *et al.*, 2013 and references therein). Such components may disturb reproductive functions, and affect several chemical, biochemical and genetic biomarkers.

Bakke *et al.*, (2013) have reviewed a number of studies carried out to determine the impact of PW discharges. They concluded that these discharges do not have a significant impact on plankton or fish species, as harmful exposure to PW is not sufficiently widescale or the population influence from locally affected individuals is not large enough. They also found that most studies supported the conclusion that significant impacts on benthic animals will be limited to within 1 km of the discharge.

Given the base case of total reinjection, a PW treatment system designed to reduce OiPW concentrations to < 20 mg/l requirements for discharge and POUK's commitment to choosing PLONOR or lowest toxicity chemicals available where possible, the magnitude of the environmental effect of the discharge of PW is considered to be negligible, whilst the significance of the environmental impact is considered **Low**.

### 7.4 Decommissioning Phase

Some discharges to sea are likely to occur during the decommissioning of the Laverda facilities at the end of field life. These will / may include the following planned discharges:

- Routine MARPOL compliant discharges from vessels associated with the decommissioning activities;
- Discharges associated with well abandonment;
- Discharges resulting from the disconnection / cutting of the jumpers, pipelines, umbilical etc.; and
- Discharges resulting from disconnection and recovery of the spools and EHC jumpers.

Discharges to sea resulting from the decommissioning activities will be described in the EIA submitted in support of the Decommissioning Programme.

In addition to chemical discharges, there is potential for some discharge of scale and debris during well abandonment. All discharges that may be contaminated with hydrocarbons will be cleaned to below minimum levels required at the time of decommissioning, or shipped to shore for treatment and disposal.

### 7.5 Cumulative and Transboundary Effects

The discharge of cuttings from the tophole sections of the Laverda and Catcher North wells will add to the total volume of cuttings deposited across the vicinity of the Catcher Area Development. However, any cumulative impacts are considered negligible, given the uniform nature of the seabed in the area and the predicted reduction in area where the EIF is considered > 5 % each year after drilling has completed.

The cumulative impact of the discharge of PW associated with the Laverda Field is considered negligible, given that total volumes of discharged produced water will be within the existing capacity of the BW Catcher FPSO.

The proposed CNDT location is *c*. 104 km from the UK/Norwegian median line, such that no transboundary impacts are anticipated from the discharges associated with the proposed drilling, installation, commissioning, production or decommissioning activities.

## 7.6 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with discharges to sea from the proposed Laverda Field Development Project.

**Proposed Mitigation Measures**

- The HDJU drilling rig will be subject to audits ensuring compliance with UK legislation;
- All vessels used will be MARPOL compliant;
- Where technically feasible POUK will prioritise the selection of PLONOR, or chemicals with a lower RQ;
- The base case is for PW reinjection (reaching a minimum target of 95 % availability); and
- The discharges of PW and associated chemicals are regulated by the OPPC and OCR regulations and reported through the Environmental Emissions Monitoring Scheme (EEMS). As such, during abnormal operations. PW sampling, analysis and reporting will be undertaken in line with the regulations and permit conditions.

Applying the risk assessment methodology described in Section 4 and taking account of the mitigation measures listed above, the significance of the environmental impact associated with the discharge of the drill cuttings is considered **Medium**. It should be noted that though considered medium, a few years after drilling has completed, the seabed is expected to have notably recovered. The significance of the environmental impact associated with all other discharges is considered **Low**.

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix A.

# 8 SEABED DISTURBANCE

A number of activities will be carried out during the proposed Laverda Field Development which have the potential to impact seabed habitats, populated by the benthic communities in the area. This section assesses the environmental impacts of the seabed disturbance during each phase of the proposed project, using the risk assessment methodology presented in Section 4.

The extent to which the benthic habitats will be impacted, depends on the size of the area that will be affected and the temporal extent of the impact e.g. positioning of the mooring anchors associated with the HDJU drilling rig can have a temporary impact in the vicinity of the anchors, whilst the area of seabed beneath the infrastructure to be installed, can be considered a permanent impact. In addition, species sensitivity and the habitat type in the area, and whether they are unique to the area or of significant conservation importance, are important in determining the overall impact of the proposed project. This section considers the impact of the different sources of seabed disturbance identified, quantifies the area of potential seabed disturbance and assesses the impact of the disturbance.

## 8.1 Drilling Phase

The impacts associated with the discharge of drill cuttings and return of excess cement to the seabed have previously been considered in Sections 7.1.1 and 7.1.2 respectively. As a result, this section focuses on the seabed impacts associated with the positioning of the drilling rig.

### 8.1.1 Drilling Rig

Having been towed to the site, four anchors will be used to position the drilling rig and once on location, the HDJU drilling rig's legs will be jacked down onto the seabed. The total area of seabed anticipated to be impacted by the installation of the HDJU drilling rig, is shown in Table 8-1.

**Table 8-1: Anticipated Worst Case Seabed Impact Associated with Positioning the HDJU Drilling Rig.**

| Structure | Maximum anticipated corridor area of impact | Total area initially impacted (includes permanent and temporary disturbance) ($km^2$) | Permanent total area of impact ($km^2$) |
|---|---|---|---|
| Anchors (and anchor chains) for positioning of the HDJU rig | Anchor: 4 anchors. Assume each anchor impacts an area of 10 m x 10 m.<br>Anchor chain: 4 anchor chains. Assumes 150 m length of each anchor chain impacts on the seabed across a maximum corridor width of 10 m. | 0.0064 | N/A |
| HDJU spud cans | 3 spud cans with 18 m diameter. Assume when initially laid down will impact on area extending 1m all around each spud can. | 0.0009 | N/A |
| **Total area impacted** | | **0.0073** | **N/A** |

## 8.2 Installation Phase

Table 2-9 summarises the subsea infrastructure and protection features to be installed as part of the proposed project. Table 8-2 summarises the total area anticipated to be initially impacted by the installation activities and the area anticipated to be permanently impacted.

**Table 8-2: Anticipated Area of Seabed impacted During Installation of the Subsea Infrastructure.**

| Infrastructure | Assumptions | Area of seabed impacted during installation ($km^2$) | |
|---|---|---|---|
| | | Temporarily & permanently impacted | Permanently impacted |
| Rock berm over the production flowline and EHC umbilical | Rock berm will be *c*. 2.4 km (L) x 8.03 m (W). Assumed a corridor width of 15 m impacted temporarily as a result of disturbed sediments. | 0.036 | 0.019 |
| Rock berm over the gas flowline | Rock berm will be *c*. 2.4 km (L) x 4.76 m (W). Assumed a corridor width of 8 m impacted temporarily as a result of disturbed sediments. | 0.019 | 0.011 |
| Mattresses at CNDT approaches | Anticipated up to 75 mattresses will be required (measuring 6 m (L) x 3 m (W)). As a worst case it is assumed that an additional area of 1 m on each side will be temporarily impacted during installation. | 0.0030 | 0.0013 |
| Mattresses at Varadero manifold approaches | Anticipated up to 140 mattresses will be required (measuring 6 m (L) x 3 m (W)). As a worst case it is assumed that an additional area of 1 m on each side will be temporarily impacted during installation. | 0.0056 | 0.0025 |
| Grout bags at CNDT approaches | 16.25 te of grout bags (650 x 25 kg) to be used. Assessment assumes 1 te of grout bags permanently impacts on 1 $m^2$ of seabed and temporarily impacts on an additional 1 $m^2$ during installation. It should be noted this is an over estimate as the grout bags will in many cases impact on the same areas as accounted for by the mattresses. | 0.00003 | 0.00002 |
| Grout bags at Varadero manifold approaches | 33.75 te of grout bags (1,350 x 25 kg) to be used. Assessment assumes 1 te of grout bags permanently impacts on 1 $m^2$ of seabed and temporarily impacts on an additional 1 $m^2$ during installation. It should be noted this is an over estimate as the grout bags will in many cases impact on the same areas as accounted for by the mattresses. | 0.00007 | 0.00003 |
| Work area / wet storage area at CNDT location | Temporary impacts associated with lay down of baskets, temporary storage of spools and umbilicals etc. Area of temporary disturbance measuring 100 m x 100 m assumed. | 0.01 | N/A |
| Work area / wet storage area at Varadero manifold location | Temporary impacts associated with lay down of baskets, temporary storage of spools and umbilicals etc. Area of temporary disturbance measuring 100 m x 100 m assumed. | 0.01 | N/A |
| **Total** | | **0.084** | **0.035** |
| Note: Separate entries for the flowlines, EHC umbilical, spools and EHC jumpers have not been added as the impacts associated with the installation of these structures occur within the footprint of the rock berms and mattresses described here. | | | |

## 8.3 Production Phase

No additional seabed disturbance is anticipated to occur during routine production operations.

## 8.4 Decommissioning Phase

The decommissioning activities will result in some temporary disturbance to the seabed. Sources of disturbance could include:

- Seabed sampling for pre-decommissioning survey work;
- Localised dredging or jetting to allow access for cutting;
- Recovery of subsea infrastructure;
- Potential temporary wet storage of items following disconnection and prior to recovery;
- Temporary positioning of baskets for recovery of tie-in spools etc.; and
- Anchoring of drilling rig.

Following discussion with BEIS and its consultees, POUK as operator, will meet survey requirements prior to the commencement of decommissioning activities.

The Environmental Appraisal submitted in support of the Decommissioning Programme, will capture the impacts associated with the disturbance of the seabed. The activities will be further detailed on the relevant MAT and associated SAT applications, including a Marine Licence in line with advice received from BEIS at the time. It is anticipated that the area disturbed by the decommissioning activities will mostly be within the area disturbed by the installation activities.

## 8.5 Seabed Disturbance Impact Assessment

Physical disturbance resulting from the drilling rig's anchors, anchor lines and spud cans, the installation of the flowlines and the EHC umbilical and the placement of rock cover, mattresses and grout bags, can cause mortality or displacement of motile benthic species in the impacted area, direct mortality of sessile seabed organisms that cannot move away from the contact area, and direct loss of habitat. In addition, disturbance from sediment re-suspension, will occur in the immediate area when the structures are initially positioned.

In addition to causing mortality or displacement of benthic animals, the stabilisation features (i.e. rock cover, mattresses and grout bags) may also create habitats for benthic organisms that live on hard substrates e.g. sponges, soft corals and tubeworms, sea slugs, hermit crabs and brittle stars.

Given the silty sandy nature of the sediment in the area, it is possible that disturbed sediment particles may be transported via tidal currents for re-settlement over adjacent seabed areas. This may have indirect negative effects on the benthic animals in the vicinity, including smothering. Sessile epifaunal species may be particularly affected by increases in suspended sediment concentrations, as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus (Nicholls *et al*., 2003). Larger, more mobile animals such as crabs and fish, are expected to be able to avoid any adverse suspended solid concentrations and areas of deposition.

It is possible that some of the filter feeders found in the area e.g. *A. islandica* and the phosphorescent sea pen (*P. phosphorea*) could be negatively impacted by suspended sediments in the water column. *A. islandica* is considered to be highly sensitive to a high degree of siltation change, but not sensitive to a low degree of siltation change (Marine

Scotland's 'Feature Activity Sensitivity Tool' (FEAST)). The proposed surface lay and rock cover of the flowlines and EHC umbilical will minimise sedimentation such that the potential impacts on this bivalve are not expected to be significant.

Any impacts on benthic animals from compression and sediment re-suspension are expected to be short lived, since most of the smaller sedentary species associated with the area (such as polychaete worms) have short lifecycles and recruitment of new individuals from outside the area disturbed will be rapid. Recolonisation of the impacted areas can take place in a number of ways, including mobile species moving in from the edges of the area (immigration), juvenile recruitment from the plankton, and burrowing species digging back to the surface. Recovery times for faunal communities following disturbance resulting from the installation activities are difficult to predict, although some studies have attempted to quantify timescales. Collie *et al*. (2000) examined impacts on benthic communities from bottom towed fishing gear and concluded that, in general, sandy sediment communities were able to recover rapidly, although this was dependent upon the spatial scale of the impact. It was estimated that recovery from a fishing trawl, could occur within about 100 days. It was assumed that recolonisation was through immigration into the disturbed area, rather than from settlement or reproduction within the area.

The benthic animals known to occur within the Catcher Area Development are expected to be indicative of the wider offshore CNS area, such that any impacts are expected to be at an individual animal level and not likely to cause a loss of species diversity. Similarly, any impacts are not expected to have a significant impact on the abundance of benthic animals in effected areas.

As discussed in Section 7.1.1, where avoidance by fish is not possible, the suspended sediments could lead to oxygen deprivation if caught in the gills.

In instances of persistent and widespread suspended sediments, there is the possibility of reduced feeding success among juvenile fish which may influence survival, year-class strength, recruitment and overall condition (Clarke and Wilber 2000). However given the reduced sediment disturbance associated with the selected flowline and EHC umbilical protection and the short duration of the activities, the impacts on fish populations in the area is not considered significant.

Given the distance of the proposed activities from the nearest wreck (4.4 km; see Section 3.6.6), none of the activities described here are expected to impact on any of the wrecks identified in the region of the Catcher Area Development.

## 8.6 Cumulative and Transboundary Effects

The infrastructure to be installed, as part of the proposed Laverda and Catcher North Field Development, will increase the footprint of the infrastructure associated with the Catcher Area Development. However, the increase in impacts will be minimised where possible e.g. by drilling both wells from the same drilling template and tying into existing infrastructure, such that the overall cumulative effect is kept to a minimum. Given the distance (*c*. 104 km) from the UK / Norwegian median line, no transboundary seabed impacts have been identified.

## 8.7 Mitigation Measures

The following mitigation measures are proposed to minimise the impacts associated with disturbance to the seabed resulting from the proposed development.

**Proposed Mitigation Measures**

- Pre-deployment surveys will be undertaken to identify suitable locations for the drilling rig anchors;
- Use of dynamically positioned vessels; and
- The use of mattresses, rockdump and grout bags will be minimised through optimal project design.

Applying the risk assessment methodology described in Section 4 and taking account of the mitigation measures listed above, the magnitude of the environmental effect on the seabed, of positioning the HDJU drilling rig is considered minor, whilst the significance of the environmental impact is considered **Medium**. The magnitude of the environmental effect of the installation of the flowlines and EHC umbilical and the associated stabilisation features is considered moderate, whilst the environmental impact is also considered **Medium.**

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix A.

# 9 UNDERWATER NOISE

This section assesses the impact of noise associated with the proposed Laverda Field Development, using the assessment methodology outlined in Section 4.

## 9.1 Introduction

Marine fauna use sound for navigation, communication and prey detection (Southall *et al*., 2007; Richardson *et al*., 1995). Therefore, the introduction of anthropogenic underwater sound has the potential to impact on marine animals by interfering with the animal's ability to use and receive sound (OSPAR, 2009b). Offshore exploration and production activities invariably generate underwater sound; for example, during geophysical exploration, during drilling activities or piling operations and from the vessel operations. The level and frequency range of sound generated varies with the type of activity.

It is generally accepted that exposure to anthropogenic sound can induce a range of adverse effects on marine life (e.g. OSPAR, 2009b). The impact of sound on an animal depends on many factors including the level and characteristics of the sound, hearing sensitivity of the species and behaviour of the species. These can vary from insignificant impacts such as temporary avoidance or changes in behaviour, to significant impacts such as auditory and physical injury (Southall *et al*., 2007; Richardson *et al*., 1995).

The Offshore Marine Regulations 2007 (as amended, 2010) make it an offence to injure or disturb European Protected Species (EPS) (including all marine mammals), where disturbance has a likelihood of impairing their ability to survive, to breed or reproduce, to rear or nurture their young, or to migrate. It also includes the likelihood of significantly affecting the local distribution or abundance of the species. New developments must assess if their activity, either alone or in combination with other activities, is likely to cause an offence involving an EPS.

## 9.2 Sound Sources Associated with the Proposed Development

Underwater sound associated with the proposed Laverda Field Development, will primarily result from vessel use and drilling operations, and placement of rock cover using a down pipe.

Vessel traffic can be considered the largest contributor to anthropogenic ocean noise, with the primary sources of sound coming from the propellers, propulsion and other machinery (Ross, 1976; Wales and Heitmeyer, 2002).

There will be some noise and vibration associated with drilling operations. This noise will propagate from any rotating machinery such as generators, pumps and the drilling unit and risers (McCauley, 1998). Drilling sounds, although of a relatively low level, will be continuous and generated for long periods throughout the drilling phase.

In addition, there will be noise associated with the rock falling through the down pipe during installation activities. This noise is also considered to be of a low level.

There are no explosives, or seismic activities associated with the proposed Laverda Field Development. As mentioned previously (Section 1.3), the impacts associated with the installation of the CNDT are outwith the scope of this ES, such that the impacts of the noise associated with piling of this structure has been assessed in a separate permit application (DRA/616).

## 9.3 Sensitivity of Receptors to Underwater Sound

The potential impact of underwater noise on receptors, depends on the actual level of noise received by the receptor and the receptor's sensitivity and response to that noise.

### 9.3.1 Marine Mammals

Section 3.4.5 discusses the marine mammals known to occur in the Development area. These are shown grouped according to the hearing range for the species in Table 9-1 (Southall *et al.,* 2007) indicating which noise sources present, produce noise relevant to each hearing range group. In many species sensitive to underwater sound, sensitivity is related to their use of high frequency sound for echolocation.

**Table 9-1: Marine Mammal Known to Occur in the Laverda Development Area and Hearing Group.**

| Functional Hearing Group | Species Known to Occur in the Laverda Development Area | Activities Producing Sound in this Band* |
|---|---|---|
| Low-frequency cetacean | Minke whale | Vessel engine and propeller noise<br>Drilling rig engine noise |
| Mid-frequency cetacean | Atlantic white-sided dolphin, white-beaked dolphin | Vessel noise especially dynamic positioning<br>Drilling rig machinery noise |
| High-frequency cetacean | Harbour porpoise | No significant high-frequency sources present |
| * The frequency bands distinguish between very broad categories of sensitivity and noise sources | | |

Richardson *et al*. (1995) reviewed the effects of vessel noise on marine mammals. They noted that it is not always possible to distinguish between effects due to the sound, sight or even smell of a vessel to an animal, but there is evidence that noise from vessels has an impact on marine mammals. Animals have been reported to display a range of reactions, from ignoring to avoiding the noise. The latter can lead to temporary displacement from an area. Vessel noise can mask communication calls between cetaceans, reducing their communication range (Jensen *et al*., 2009). It is not obvious whether temporary behavioural reactions, translate into long-term effects on an individual or population. Exposure to low frequency ship noise, may be associated with chronic stress in whales; Rolland *et al*. (2012) reported a decrease in baseline levels of stress-related faecal hormones concurrent with a 6 dB reduction in underwater noise along the shipping lane in the Bay of Fundy, Canada, when traffic levels decreased. The development area around Laverda Field presents many background noise sources of vessel movements, to which marine mammals are exposed.

### 9.1.1 Fish

Fish species differ in their hearing capabilities depending on the presence of a swim bladder, which acts as a pressure receiver (McCauley, 1994). Most fish can hear within the range of 100 Hz to 1 kHz, with some able to detect lower frequencies. Within this range, the hearing threshold varies from approximately 50 dB re 1 µPa for hearing specialists, to 110 dB re 1 µPa for non-specialists. Fish with a connection between the swim bladder and otolith system, have more sensitive hearing and may detect frequencies up to 3 kHz (Popper *et al*., 2003). Many species of fish produce sounds for communication, that are typically emitted at frequencies below 1 kHz (Montgomery *et al*., 2006). This information suggests that sound from vessels, which is primarily between 10 Hz and 10 kHz and is strongest at 50 Hz to 1 kHz, is likely to be within the frequency range of sound detection for most fish species.

Anthropogenic noise has the potential to interfere with acoustic communication, predator avoidance, prey detection, reproduction and navigation in fish. The effects of "excessive" noise on fish, include avoidance reactions and changes in shoaling behaviour (Slabbekoorn *et al*., 2010). Prolonged avoidance of an area, may interfere with feeding or reproduction or cause stress-induced reduction in growth and reproductive output.

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

## 9.4 Cumulative and Transboundary Effects

There will be a modest increase in activities in the Catcher Development Area which will result in underwater noise; namely from the presence of the HDJU drilling rig and additional vessel movements. Given that these activities will occur within a well-established area for oil and gas activity and will be short term in nature, cumulative impacts are not expected.

The Laverda subsea tieback will be located c. 104 km from the UK/Norwegian median line, and therefore no transboundary impacts associated with the underwater noise from the HDJU drilling rig, or vessels, are expected.

## 9.5 Mitigation Measures

The vessel and drilling operations associated with the proposed Laverda Field Development, do not require significant mitigation measures to minimise the impact of underwater noise.

| Proposed Mitigation Measures |
|---|
| • Optimise duration of drilling and installation activities.<br>• No specific mitigation measures are recommended for the pipelay, drilling and vessel operations associated with the proposed project beyond good maintenance of equipment to reduce sound levels. |

It is likely that short term behavioral effects may be observed among cetaceans as a result of vessel and drilling activities, such that the magnitude of the environmental effect is considered minor, as the sounds are considered typical of the area. The overall impact significance is therefore considered to be **Medium.**

The proposed project will be conducted in compliance with all NMP policies; an assessment against the relevant NMP objectives is given in Appendix A.

# 10 WASTE MANAGEMENT

This section discusses the types of waste likely to be generated as a result of the proposed Laverda Field Development, and the waste management procedures that will be implemented to minimise and monitor the volumes produced and disposed to landfill. Waste will be generated during all phases of the project.

POUK is committed to reducing waste production and to managing all produced waste, by applying approved and practical methods and by adhering to a waste hierarchy similar to that shown in Figure 10-1. Waste will only be disposed of if it cannot be prevented, reclaimed or recovered. All wastes will be managed in accordance with POUK's Waste Management Procedure and via the existing waste contract. The procedure establishes the controls required to manage the hazards associated with the transportation and disposal of waste from offshore sites and the processes, and verification activities, necessary to ensure legal obligations are satisfied.

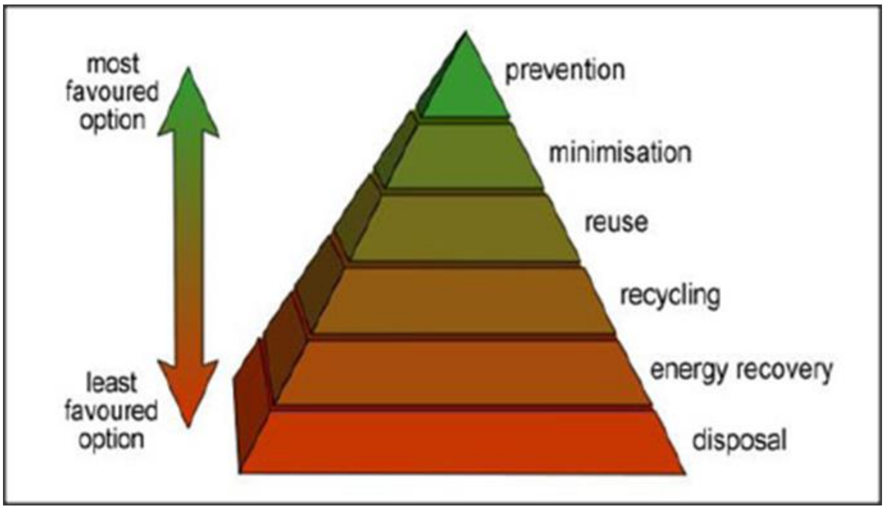



**Figure 10-1: Waste Hierarchy.**

Consent to transfer wastes to the United Kingdom shore is not required, but Duty of Care (under the Environment Protection Act 1990) makes it the waste producer's responsibility, to ensure that waste is only transferred to an appropriately licensed carrier who should have a Waste Carrier Registration. Transfer of Controlled Waste requires a Transfer Note to be completed (or Consignment Note in the case of Special Waste). The Transfer Note details the type and quantity of waste, from whom and to whom the waste has been transferred, the category of authorised person to whom the waste has been consigned, relevant licence numbers, time, place and date of transfer.

## 10.1 Vessel Waste

Waste will be generated from a number of vessels associated with the proposed development including AHVs, survey, supply, ERRV and construction vessels. Waste from these vessels will be managed in line with the individual vessel Waste Management Plan (WMP) in accordance with MARPOL requirements, which regulate discharges of waste to sea from ships.

## 10.2 Drilling Waste

Drilling rigs generate various waste products during routine operations including LTOBM contaminated cuttings, waste oil, chemical and oil contaminated water and scrap metal. Wastes will be minimised by use of appropriate procurement controls, and all wastes will be properly segregated for recycling/disposal/treatment. The appointed waste management contractor will supply monthly reports of waste sent to shore, will complete Controlled Waste Transfer Notes as required. Records of monthly waste disposal activities and Waste Management Duty of Care audits, will also be carried out.

LTOBM contaminated cuttings will be shipped to shore for disposal. The chosen waste contractor will thermally treat the cuttings onshore and any oil that is separated out may be used as an energy source on site. Any excess oil will be stored for onward transportation to oil recyclers. Process water will be used to dampen the dry cuttings, before final disposal to landfill.

## 10.3 Installation Phase

Installation activities will routinely generate a number of wastes including scrap metal, wooden crates etc. All wastes will be properly segregated for recycling/disposal/treatment in accordance with POUK’s Waste Management Procedure, and Controlled Waste Transfer Notes will be completed.

## 10.4 Production Phase

The BW Catcher FPSO complies with POUK’s waste management procedures. Waste Transfer Notes will continue to be completed as required, and records on monthly waste disposal activities will be maintained.

### 10.4.1 General Waste

On the BW Catcher FPSO, general waste streams are segregated by personnel at the source of generation, and manually handled to the appropriate labelled waste receptacle, until transferred onshore for disposal. All waste is segregated in accordance with Waste Management Procedures, and Controlled Waste Transfer Notes will be completed. Waste Management Duty of Care audits, will also be carried out. Production of general waste on the BW Catcher FPSO is not expected to change as a result of the proposed Laverda Field Development.

### 10.4.2 Laboratory Waste

The proposed Laverda Field Development is not expected to result in a change to the current waste streams occurring at the BW Catcher FPSO installation. As for general waste streams, a WMP is in place to minimise laboratory waste. Production of laboratory waste on the BW Catcher FPSO, is not expected to change as a result of the proposed Laverda Field Development.

### 10.4.3 Special Waste

The BW Catcher FPSO ships to shore a number of hazardous solid and liquid waste streams. The types of hazardous wastes handled on the BW Catcher FPSO will not change as a result of the proposed Laverda Field Development.

## 10.5 Decommissioning Phase

The waste generated as a part of decommissioning activities, will be a combination of both Hazardous (Special) and Non-Hazardous wastes. As operator, POUK will have in place a WMP to identify, quantify (where possible) and discuss available disposal options for waste, resulting from decommissioning activities. Where possible, materials will be recycled or sold and reused, taking into account a waste hierarchy similar to that shown in Figure 10-1.

It is intended that recovered infrastructure will be returned to shore and transferred to a decommissioning facility, which will have all necessary approvals and licences in place and possess the capability to reuse or recycle the majority of recovered material. The minimisation of waste is a factor considered at every stage of the project.

## 10.6 Cumulative and Transboundary Effects

There will be a modest increase in waste generation as a result of the proposed Laverda Field Development. Waste will be managed in line with existing procedures and significant cumulative or transboundary impacts are not expected.

## 10.7 Mitigation Measures

The following mitigation measures are proposed to minimise the waste produced from the proposed Laverda Field Development.

**Proposed Mitigation Measures**

- POUK will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle;
- Existing asset and vessel WMPs will be followed;
- Only permitted disposal yards/landfill sites will be used.

With the application of the above control measures, the magnitude of the environmental effect of the waste generated during the drilling phase is considered moderate, whilst it is considered negligible for the installation phase. For the drilling and installation phases, the significance of environmental impact of the waste produced is considered **Medium.** Relative to existing waste production at the BW Catcher FPSO during the production phase, there is no anticipated increase in waste, as a result of the proposed Laverda Field Development.

# 11 ACCIDENTAL EVENTS

This section provides an overview of potential hydrocarbon releases at each stage of the proposed Laverda Field Development. The worst case hydrocarbon release is associated with an accidental hydrocarbon release from a well blowout. In accordance with current guidance (BEIS, 2018), only the blowout scenario is assessed in detail.

## 11.1 Overview of Potential Hydrocarbon Releases

### 11.1.1 Drilling Phase

#### *11.1.1.1 Loss of contaminated discharges*

During drilling, in addition to a potential well blowout (see Section 11.1.1.2), accidental releases of contaminated discharges could include the loss of: cleaning chemicals, mud inventory, brine contaminated with LTOBM, cuttings containing LTOBM and oily slops. There is also a risk of an accidental spillage of mud or diesel, during bunkering operations.

These releases could result in toxic or sub-lethal effects on sensitive organisms and ecosystems. The resultant impacts are dependent on spill size, prevailing wind, sea state, temperature and sensitivity of the environmental receptors (e.g. benthic species, fish, marine mammals, birds and protected areas) affected.

To minimise the likelihood of such accidental events and their impact, should they occur, approved operational procedures will be adhered to. For example, the quantities of chemicals stored on the drilling rig will be optimised. COSHH assessments will be completed and Safety Data Sheets (SDS) will be made available. Where possible given technical requirements, chemicals that are PLONOR, have a RQ <1, or do not carry substitution warnings will be prioritised. Spill kits will be located in close proximity to chemical and oil storage areas, to enable a quick response.

Procedures, in line with best industry practice guidelines, will be in place to minimise the risk of an accidental spill from bunkering. These will include, for example, regular checks of the integrity of the hose and competence of operators. Trained personnel will undertake bunkering operations in accordance with approved procedures. Containment facilities and drains will be inspected as part of HSE Management System audits.

An approved drilling rig TOOPEP will be in place to respond to an accidental hydrocarbon release. POUK is a member of Oil Spill Response Limited (OSRL) and the Offshore Pollution Liability Association Ltd. (OPOL). Local access to dispersant will be available via the ERRV. Any accidental hydrocarbon release from the drilling rig will be responded to, in accordance with arrangements set out in the drilling rig TOOPEP.

Given the relatively low volumes involved, the magnitude of effect is considered to be negligible. Pollution would not beach or cross a median line. However, when the likelihood of these accidental events taking place is taken into account, the environmental risk is considered to be **Medium**. This risk will be reduced to ALARP and managed under the mitigation measures described, such that it is considered acceptable.

#### 11.1.1.2 Well blowout

A well blowout refers to the uncontrolled release of hydrocarbons from a well, after the pressure control systems have failed. Primary well control is achieved by maintaining a hydrostatic pressure in the wellbore, greater than the pressure of the fluids in the formation being drilled, but less than the formation fracture pressure. In a worst-case scenario, there can be insufficient pressure in the wellbore fluids (i.e. the drilling mud or completion fluids) to resist formation pressure and an influx occurs. Wellbore fluids are carefully designed, monitored and actively managed to prevent such occurrences.

In the unlikely event of an influx, the flow of reservoir fluids into the well is stopped by closing the BOP, which is the initial stage of secondary well control. The BOP has multiple sets of rams that can close off the well bore in an emergency. Secondary well control is completed by circulating the well with kill weight fluid, and displacing the influx out of the well. If primary and secondary well control fails, a blowout can occur.

During production, downhole safety valves are in place to seal wells should an unplanned well event occur. These downhole safety valves, are in addition to valves contained within the tree. After production has ceased, wells are plugged with cement and decommissioned.

The International Association of Oil and Gas Producers (OGP) has issued datasheets (OGP, 2010) on well blowout frequencies for drilling operations of a North Sea Standard, where the operation is performed with a BOP installed and where the “two barrier” principle is followed. The dataset is derived from the Foundation for Scientific and Industrial Research International (SINTEF) well blowout database, where a blowout is defined as an incident where formation fluid flows out of the well, or between formation layers, after all the predefined technical well barriers or the activation of the same have failed. The blowout frequencies have been calculated per well drilled in the North Sea and are not an annual frequency.

The blowout frequency for development drilling of an oil well is $4.8 \times 10^{-5}$ (or 4.8 blowouts for every 10,000 drilling operations), indicating that the likelihood of a blowout occurring, is very remote. The likelihood of a blowout occurring at a maximum flow rate, or for an extended period, is lower still.

Spill modelling has recently been undertaken to support the Varadero Drilling Temporary Operations Oil Pollution Emergency Plan (TOOPEP) (POUK, 2016b) using the Oil Spill Contingency and Response (OSCAR) model developed by SINTEF, including a well blowout from the Varadero VP3 well. This is the worst-case hydrocarbon release scenario for the Catcher Area and can be used to assess the impacts of a Laverda well blowout, as discussed further in Section 11.2. The Varadero VP3 well is located c. 2.3 km west southwest of the CNDT.

#### 11.1.1.3 Loss of fuel inventory from rig

It is acknowledged that other spills, such as a loss of total fuel inventory from the drilling rig, could occur. Specific modelling studies have not been carried out to determine the fate of a loss of fuel inventory at the site, given that any impacts would be expected to be within the envelope of worst-case impacts associated with a well blowout (see Section 11.2). A loss of fuel inventory from a drilling rig whilst at the Laverda Field, would be subjected to a number of processes including spreading, evaporation, natural dispersion, sedimentation and biodegradation. Results from the modelling of a loss of diesel inventory (3,550 $m^3$) from a non-production installation in the Varadero Field, showed the impact of a diesel release would be restricted to the vicinity of the release location (POUK, 2016b). Similarly, a relatively small surface area and volume of water would be expected to be impacted by a loss of fuel inventory from a drilling rig at Laverda. Shoreline beaching is not expected (<1% probability) and in the unlikely event that diesel would beach, the predicted maximum volume accumulated onshore would be only 119 $m^3$, *c.* 3% of the quantity released. The minimum beaching time would be seven days. There is a maximum 10-20 % probability of diesel crossing in to Norwegian waters, with a minimal arrival time of 3 days. The magnitude of effect of such a release, is therefore considered to be minor.

The likelihood of a collision resulting in the loss of fuel inventory from the drilling rig is considered to be unlikely, such that the environmental risk is considered **Medium**. This risk will be reduced to ALARP and managed under the mitigation measures described, such that it is considered acceptable.

### 11.1.2 Installation and Commissioning Phase

During the Installation and Commissioning Phase, there is a risk of accidental discharges of water-based hydraulic fluids or treated seawater. This release could result in short term localised effects on water quality, flora and fauna.

To mitigate the potential of such a release occurring, containment facilities will be inspected as part of the vessels HSE Management System audit. Industry standard operating procedures and checks will be carried out, to prevent such a release where possible. In addition, a chemical risk assessment will be undertaken as part of the Production Operation MAT application. Chemicals that are PLONOR, have a HQ < 1 and / or do not carry substitution warnings will be prioritised where technically possible.

With the above mitigation measures in place, the magnitude of the environmental effect of an accidental discharge of water-based hydraulic fluids or treated seawater, is considered to be negligible, whilst the environmental risk is considered **Medium** and is therefore acceptable when managed within the additional mitigation measures described.

### 11.1.3 Production Phase

The BW Catcher FPSO has an approved OPEP in place (BEIS Reference No. 15113) and this will be amended to include production from the Laverda Field. The likelihood of an accidental event at the FPSO is not considered to increase as a result of the Laverda tie-back, such that it is not discussed further.

## 11.2 Environmental Impact of a Well Blowout

This section assesses the impact of a surface well blowout at the proposed Laverda well location, using the modelling results from Varadero Drilling TOOPEP (POUK, 2016b). The Varadero modelling comprised probabilistic (stochastic) modelling and deterministic modelling of the spill scenario, resulting in the highest volume of beached oil. Modelling results are assessed in relation to the receptors likely to be impacted. A summary of the well blowout scenario modelled to support the Varadero TOOPEP, is presented in Table 11-1. The oil type used in the model was the Svale analogue which is considered a similar oil type to Varadero and Laverda and has been used as the basis for the following sections (Table 11-2). The worst case hydrocarbon release rate and total release quantity considered in the model (238,288 $m^3$), is much larger than the expected release rate and volume at the Laverda well (145,878 $m^3$).

**Table 11-1 Modelled blowout release parameters.**

| Scenario and location | Hydrocarbon type | Release rate | Release duration[1] | Total quantity released | Release depth |
|---|---|---|---|---|---|
| Varadero<br>Block 28/9<br>56° 48' 21.99" N<br>00° 42' 15.51" E | Varadero Crude.<br><br>Svale used as analogue | Variable | 81 days | 238,288 $m^3$ | At surface |
| 1. Total model duration included an additional 20 days following the end of the release. | | | | | |

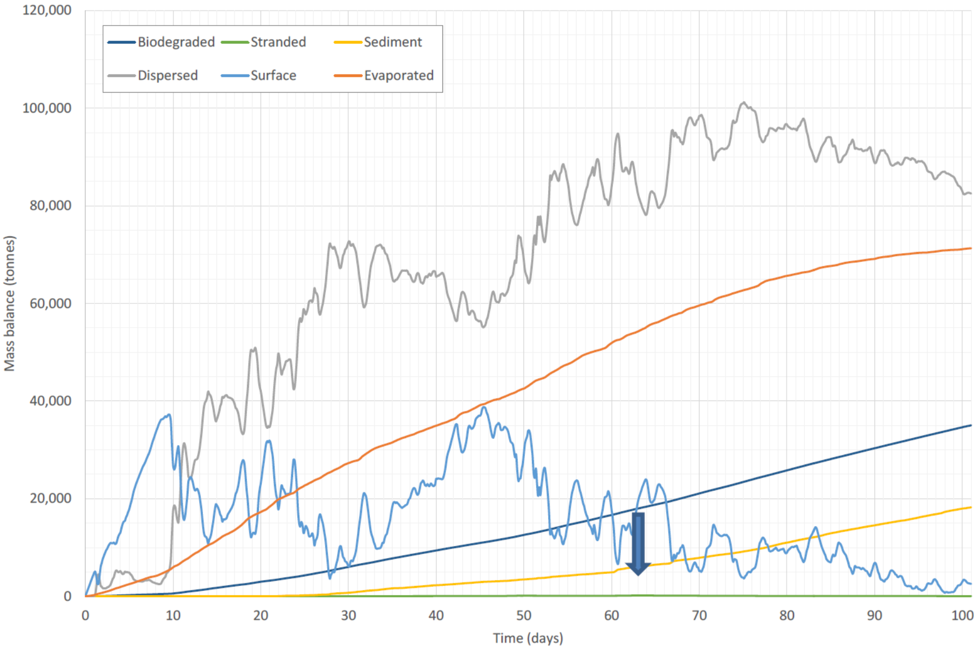
**Table 11-2 Oil properties for Laverda, Varadero and analogues**

| Oil type | Specific Gravity | Viscosity (cP) | Wax content (%) | Asphaltene content (%) | Pour point (Celsius) |
|---|---|---|---|---|---|
| Laverda | 0.919 | 270 (at 20°C) | 1.2 | - | -33 |
| Varadero | 0.894 | 66.1 (at 20°C) | 2.10 | 0.55 | -45.0 |
| Svale (analogue) | 0.914 | 257 (at 5°C) | 2.12 | 0.32 | -33.0 |

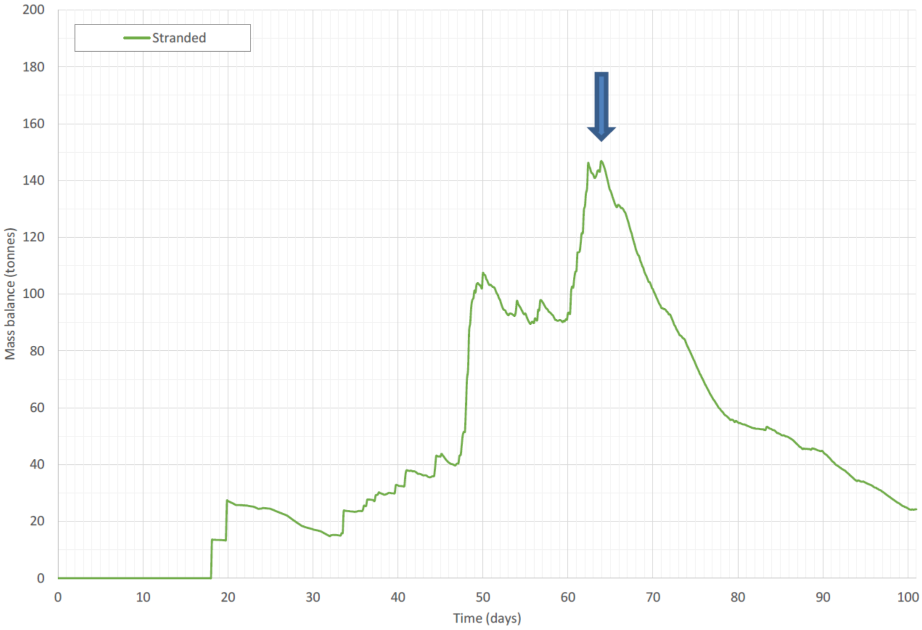
### 11.2.1 Summary of Modelling Results

#### *11.2.1.1 Fate of hydrocarbons (Mass balance)*

Figure 11-1 illustrates the fate of released hydrocarbons from the well blow-out scenario identified as resulting in the highest volume of beached oil, over a 101-day period. Approximately 39 % is dispersed in the water column, 34 % has evaporated, and 17 % has biodegraded after 101 days. Of the remaining 10 %, approximately 9 % has gone into sediments, with the residual *c*. 1 % either being stranded or remaining on the sea surface (POUK, 2016a). The maximum quantity of oil on shore over the model run duration was achieved at 63 days and 21 hours after the start of the release, as indicated in Figure 11-1.




a)




b)

**Figure 11-1 a) Mass balance plot for deterministic model run (maximum oil on shore at 63 days and 21 hours). b) Maximum oil on shore over model run duration (different scale).**

### *11.2.1.2 Oil on the surface*

Following a well blowout there is a high probability (90-100 %) of a visible surface sheen with a thickness > 0.3 µm extending over a large area, predominantly to the east of the release location (Figure 11-2). Surface oil is therefore expected to cross the median line in to Norwegian waters (up to 100 % probability) and is highly likely to disperse in to Danish, Swedish, German and Dutch waters (POUK, 2016b). Note a sheen thickness > 0.3 µm is the minimum thickness expected to produce negative impacts on sea life encountering oil at the sea surface.

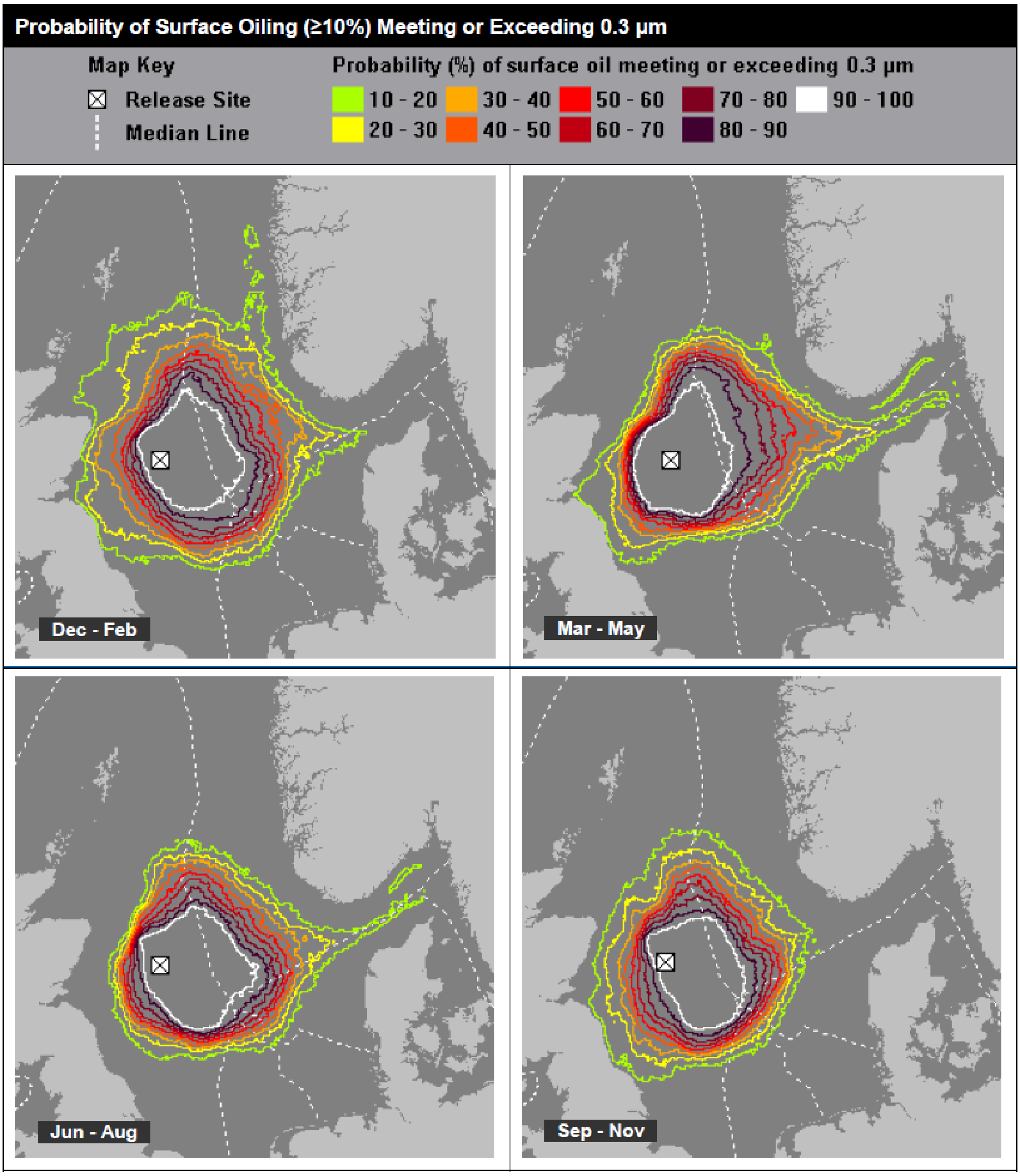



**Figure 11-2 Probability of a surface sheen > 0.3 µm at some point during the subsea well blowout.**

Deterministic modelling of the spill scenario resulting in the highest volume of beached oil was completed (release starting 16th April 2012). For that specific run, the accumulated maximum surface oil thickness over the period, is shown in Figure 11-3. Oil thickness of greater than 0.3 µm is exceeded over a large area, although only very small quantities of oil are predicted to cross the UK / Norway median line.

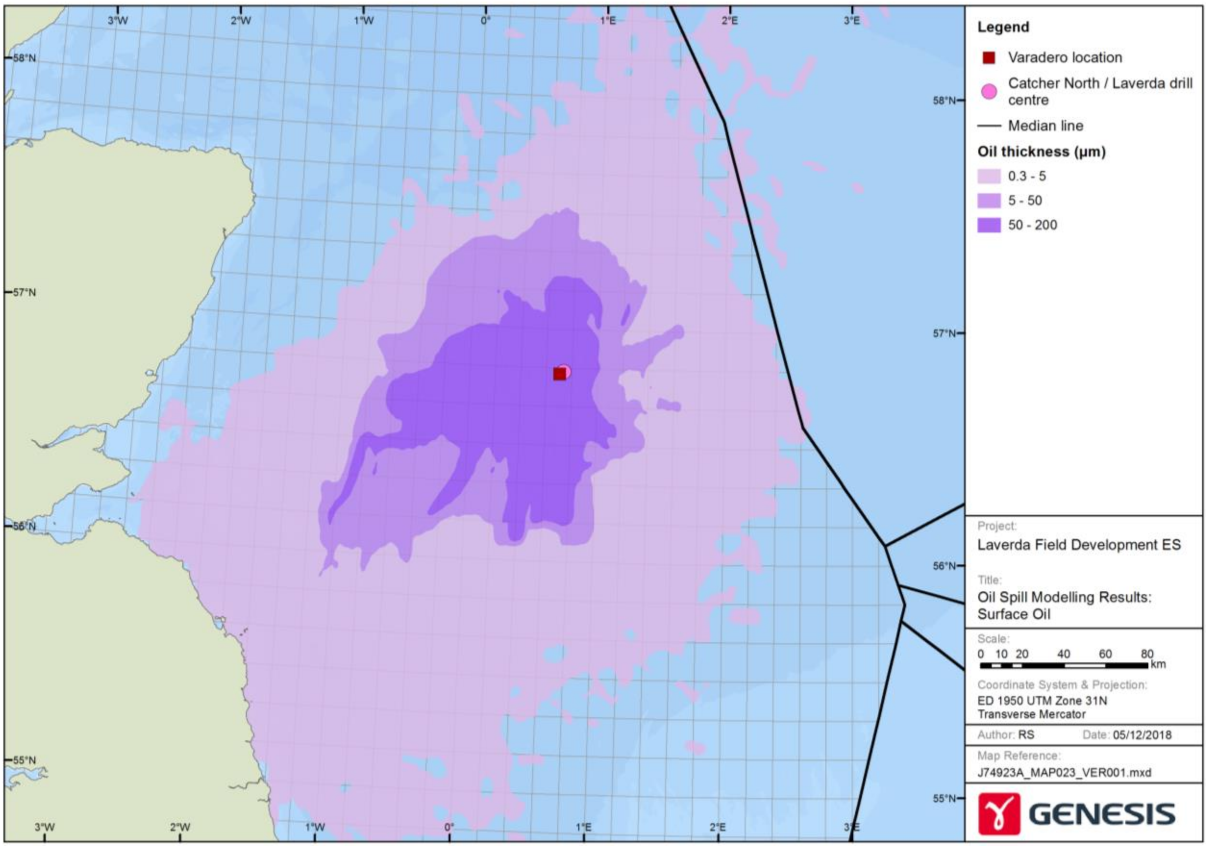



**Figure 11-3 Maximum accumulated surface oil thickness for deterministic run.**

#### *11.2.1.3 Shoreline beaching*

Stochastic modelling showed that following a blowout, the probability of oil beaching on shorelines in Denmark and Norway is highest in winter (Dec-Feb) at up to 22% and 13% respectively, and highest in Sweden in summer at 6% (Jun-Aug). The probability of oil beaching on international shorelines is below 6% at other times of year, except for in Denmark, where the probability is 19% in autumn (Sep-Nov).

Beaching in the UK, is most likely in North East England (17%) in the winter (Dec-Feb) and is at or above 10% likelihood on the shores of the Grampian, Tayside/Fife, and Lothian/Borders regions in Scotland, and North East England for much of the year. In the summer (Jun-Aug), beaching would not be expected in Scotland, and would be unlikely (up to 2%) in North East England and the Yorkshire and Humber region.

Deterministic modelling showed that that the maximum amount of oil impacting on the UK shoreline at any one time is 283 $m^3$, and the length of shoreline impacted could be 115 km (POUK, 2016a). No coastline would be impacted by heavy oiling, based on the International Tanker Owners Pollution Federation (ITOPF) definition (≥10 litres per $m^2$ or 9.187 kg/$m^2$ for Laverda crude) (ITOPF, 2014). The highest concentration of shoreline oiling was found to be 2.26 kg/$m^2$, on the coast of North East England, which falls into the moderate ITOPF oiling category (Figure 11-4).

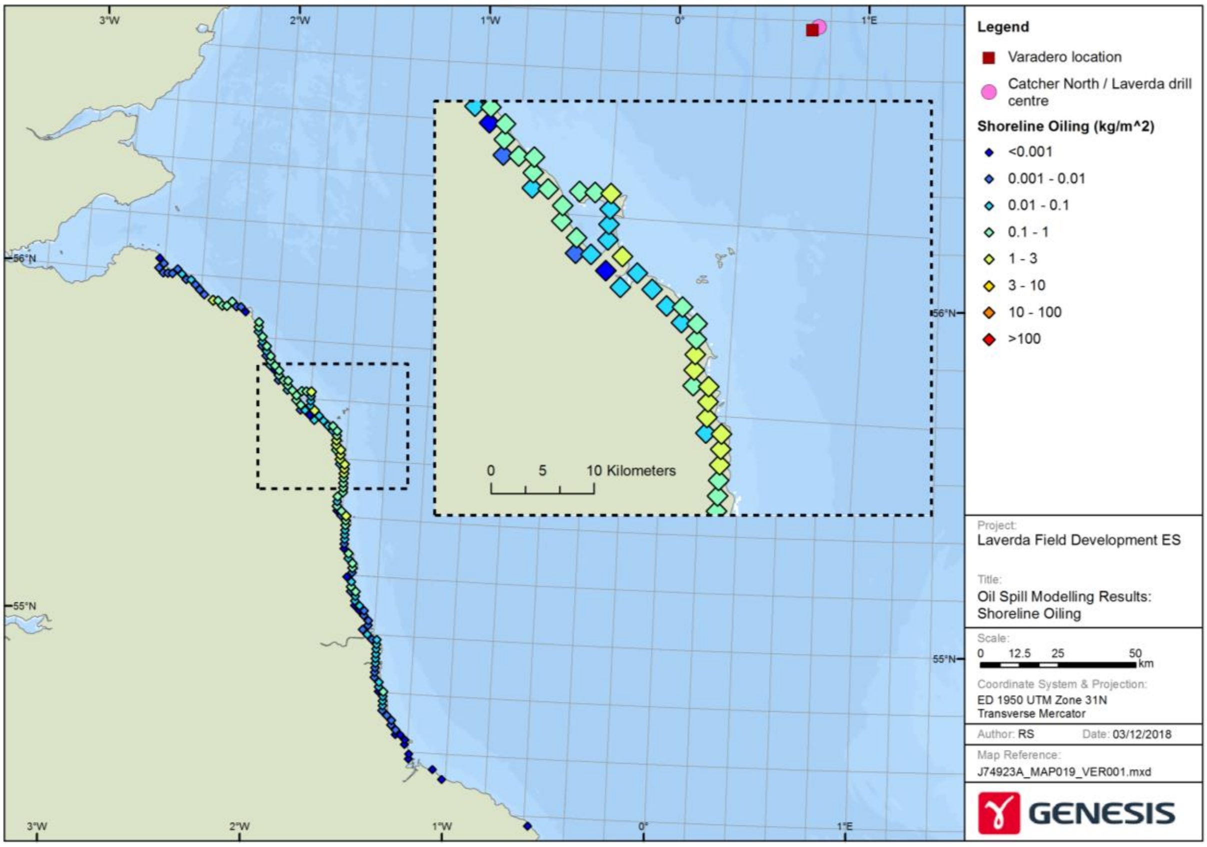



**Figure 11-4 Shoreline oiling density at point of maximum oil on shore (deterministic modelling).**

### *11.2.1.4 Water column concentrations*

Figure 11-5 shows the accumulated area of sea that is affected by a hydrocarbon concentration ≥ 25 ppb following a surface well blowout scenario, Total water column concentrations ≥ 25 ppb are expected to impact on fish eggs and larvae, which are considered among the most sensitive organisms in the water column (see Section 11.2.2.3).

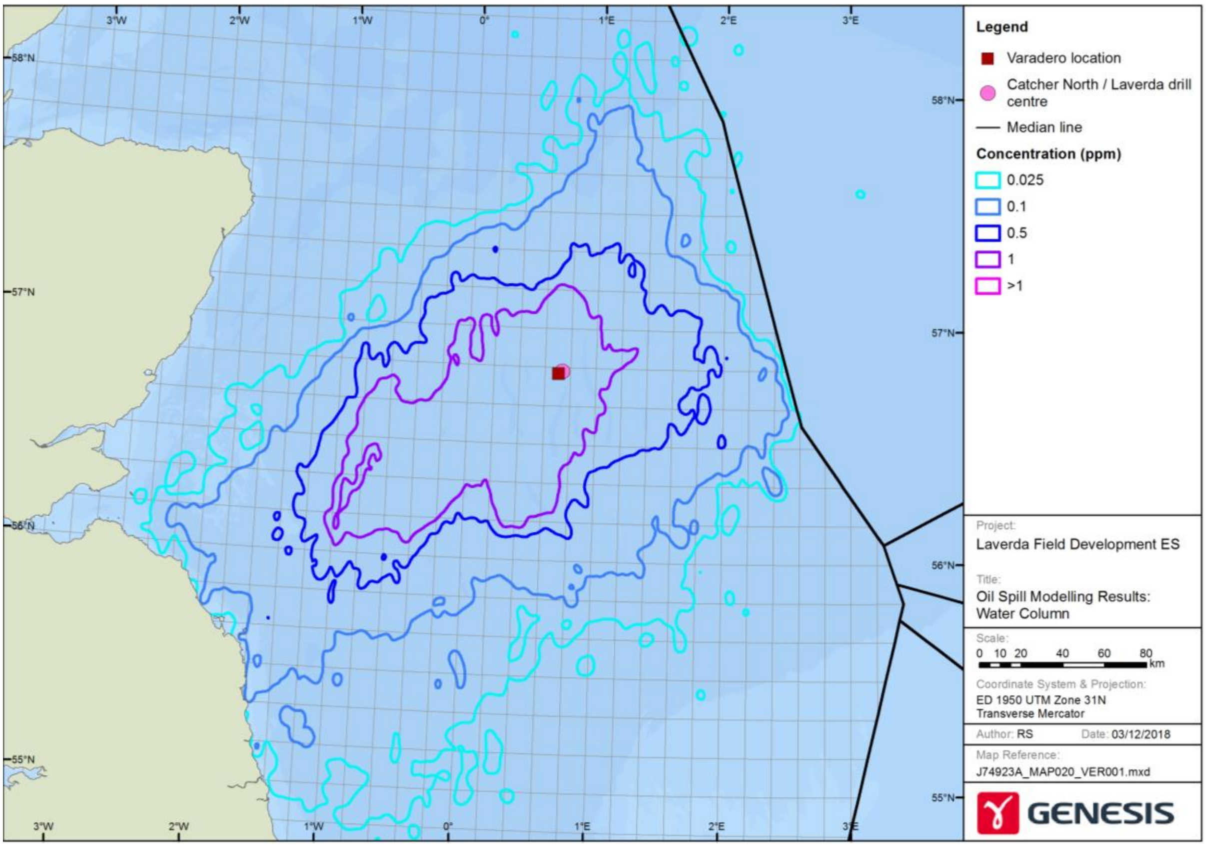



**Figure 11-5 Maximum accumulated oil concentrations in the water column (deterministic modelling).**

## 11.2.2 Impact of a Well Blowout on Receptors

The modelling results suggest that a number of environmental receptors, would be impacted in the event of a well blowout at Laverda. The impact on these receptors is discussed here.

### *11.2.2.1 Impact on plankton*

The planktonic community is composed of a range of microscopic plants (phytoplankton) and animals (zooplankton), that drift with the oceanic currents. These organisms form the basis of marine ecosystem food chains. Because oil can float on the water's surface and disperse within the ocean as it weathers, plankton are exposed to both floating oil slicks and to small dissolved droplets of oil in the water column (Cormack, 1999; Almeda *et al*., 2013).

Changes in the patterns of distribution and abundance of phytoplankton, can have a significant impact on the entire ecosystem (Ozhan *et al*., 2014). Both oil and oil biodegradation can impact phytoplankton, in the immediate vicinity of a spill. Oil slicks can inhibit air-sea gas exchange and reduce sunlight penetration into the water column, and hinder photosynthesis and phytoplankton growth (González *et al*., 2009). The PAHs in the oil also affect phytoplankton growth, with responses ranging from stimulation at low concentrations of oil

(1 mg/l i.e. 1,000 ppb), to inhibition at higher concentrations (100 mg/l i.e. 100,000 ppb; Harrison *et al*., 1986). After the Macondo blowout in the Gulf of Mexico in 2010, it has been speculated that phytoplankton community structure changed and biomass increased due to a combination of the detrimental effects of oil contamination, and the beneficial effects of decreased predation (Abbriano *et al*., 2011).

Zooplankton at the air-sea interface are thought to be particularly sensitive to oil spills, due to their proximity to high concentrations of dissolved oil and to the additional toxicity of photo-degraded hydrocarbon products at this boundary (Bellas *et al*., 2013). Following an oil spill, zooplankton may suffer from loss of food in addition to the direct exposure of oil toxicity, resulting in death from direct oiling as well as impaired feeding, growth, development, and reproduction (Blackburn *et al*., 2014 and references therein).

Tolerance to oil varies by species, and a study of Gulf of Mexico zooplankton communities found that mortality tended to be more dependent upon exposure time than concentration of oil, though the highest oil concentrations led to the highest mortalities (50 % after 50 hours; Lee and Nicol, 1977). Although individual zooplankton species may have experienced relative mortality or enhanced growth, the direct negative effects of oil were probably largely offset by a decrease in predation.

The limited swimming ability of the free-floating early life stages (meroplankton i.e. eggs and larvae) of invertebrates such as sea urchins, molluscs and crustaceans renders them unable to escape oil-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 (Blackburn *et al*., 2014 and references therein). For example, the eggs and larvae of planktonic oysters exposed to oil show impaired development and decreased settlement of juveniles (Geffard *et al*., 2002a, 2002b; Choy *et al*., 2007). After the Prestige oil tanker spill off the northwest coast of Spain in November 2002, sea urchin embryo development was inhibited by as much as 50 % when fuel oil content in the water was over 3.8 % whilst oil levels below 1.9 % did not appear to be toxic (Fernandez *et al*., 2006).

Generally, studies on the long-term effects of oil contamination on plankton are limited, because few regions have comprehensive pre-spill data on plankton communities to use for comparison. Furthermore, the large degree of natural variability in plankton populations, and the effects of ocean processes and climate on their distribution, can further complicate detection of impacts. Existing research has shown substantial short and long-term toxicity of oil and its weathered by-products to eggs, larvae and mature zooplankton following large spills. Johansson *et al*. (1980) documented short term impacts on zooplankton biomass, in the month following the Tsesis oil spill off the coast of Sweden in 1977. Though the guts and feeding appendages of the zooplankton were contaminated with oil for the three-week duration of the study suggesting the potential for even longer term population effects, the actual biomass levels were re-established within five days. In contrast, the 480,000 metric tonne loss of oil over a 10-month period from the Ixtoc I well in the Gulf of Mexico in 1979, resulted in a fourfold decrease in zooplankton concentrations for three years afterwards (Guzmán del Próo *et al*., 1986).

The distribution of plankton across the UKCS is generally uniform and widespread, such that when the area of water impacted by a blowout at Laverda is taken into account, the magnitude of effect on plankton is considered to be a minor. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

#### *11.2.2.2 Impact on benthic animals*

It can be seen in Figure 11-1 that when compared to the total well blowout volume, a relatively small portion of oil is likely to settle in the sediment. A mass of oil of 50 mg per 1 kg of sediment (50 mg/kg), has been identified as the threshold above which toxic effects on benthic fauna may begin to be discernible. In response to oil exposure, benthic animals can either move, tolerate the pollutant (with associated impacts on the overall health and fitness), or die (Gray *et al*., 1988; Lee and Page, 1997). The response to oil by benthic species differs depending on their life history and feeding behaviour, as well as the ability to metabolise toxins, especially PAH compounds. Benthic species could be vulnerable to oil deposition in the sediment, which has been investigated in the oil spill modelling. Modelling of deposition of oil in seabed sediments was not available, however, it is reasonable to assume that some areas of seabed would be contaminated to levels with potential to impact benthic species.

The area is characterised by benthic communities associated with offshore circalittoral sand, predominantly fine slightly silty sand with shell fragments. The infaunal communities are typical of moderate to low energy deep-water soft sediments in the Central North Sea area, with a community dominated by small polychaetes. In some areas, the seabed is composed of a greater proportion of coarse materials in the form of shell and gravel, described as circalittoral mixed sediments, and occasional drop stones provide low energy circalittoral rock habitat with attached hydroids and occasional cup corals. Other epifauna include sea pens, anenomes, urchins, tube worms, starfish, brittlestars, crabs and molluscs.

The responses of polychaete populations to oil spills are complex and varied, and are thought to differ depending on their different feeding strategies and trophic relationships in benthic environments. Some species decrease in abundance after an oil spill, whilst others may be the first colonisers in the aftermath of oil spill die-offs (Blackburn *et al*., 2014 and references therein). For example, *Capitella capitata* has been found to be amongst the first colonisers in the aftermath of a spill. This species thrives in the absence of competition and is a non-selective deposit feeder, consuming detritus and algae and benefitting from organic pollution.

In contrast numbers of *Heteramalla sarsi* (a predatory polychaete that feeds on benthic amphipods) dropped to less than 5 % of their pre-spill biomass following the 1977 Tseis oil spill in the Baltic Sea. This decrease in polychaetes was in correlation with a decrease observed in amphipods in the region (Elmgren *et al*., 1983). The most abundant polychaete in the area, *Paramphinome jeffreysii*, is reported to be tolerant of hydrocarbon concentrations (Olsgard and Grey, 1995).

Acute oil toxicity to echinoderms following major oil spills, have resulted in significant starfish mortality e.g. a large number of starfish mortalities resulted from the grounding of the Morris J Bergman barge in Puerto Rico in 1994 and from the Erika oil spill off France in 1994 (Mignucci-Giannoni ,1999; Joly-Turquin *et al*., 2009). Multiple sub lethal impacts of oil pollution on starfish, have also been documented in laboratory studies including detrimental effects on growth, locomotion, ability to detect prey and feeding behaviour (Ordzie and Garofalo 1981; O'Clair and Rice 1985; Temara *et al*., 1999). The magnitude of these effects differed, depending on the type of oil and/or starfish species.

The generally widespread distribution of benthic species populations on the UKCS means that they are unlikely to be significantly affected at the population level, rather the impact would be more on an individual animal level. However, given that some of the oil could settle at toxic concentrations within designated areas, the magnitude of effect is considered significant. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

#### *11.2.2.3 Impact on fish*

Water column hydrocarbon concentrations > 25 ppb, are considered to have potential effects on fish eggs and larvae that are considered among the most sensitive organisms in the water column. The oil spill modelling predicted that the total impacted cumulative (over the whole model run) area of water where concentrations were > 25 ppb, could be up to 59,317 $km^2$ (Figure 11-5).

Exposure of fish to contaminants can occur either through uptake of dissolved fractions across the gills or skin, or direct digestion of the pollutant. Fish spending the majority of their life-cycle in the water column, are likely to receive the highest exposure to contaminants that remain in solution, though some will also accumulate sediment bound contaminants indirectly through their diet (i.e. digestion of animals that have accumulated the contaminants in their tissues). Fish associated with the seabed (e.g. flatfish), are more exposed to particle bound contaminants with the main exposure route being either directly through ingestion of contaminated sediments, or through their diet. Seabed dwelling organisms can also absorb contaminants through the surface membranes, as a result of contact with interstitial water. Once the oil disappears from the water column, fish generally lose their oil content very quickly. This rapid loss of oil from fish tissue, is linked to the fact that fish will metabolise accumulated hydrocarbons very rapidly (Krahn *et al*. 1993).

Test results following the Braer oil spill south of Shetland in 1993, showed that a spill of its size (c. 85,000 tonnes) in which the oil is rapidly dispersed through the water column, can quickly lead to highly contaminated and tainted fish and shellfish. This differs to the observations made following the Sea Empress spill off the southwest of Wales in 1996 (c. 72,000 tonnes), whereby hydrocarbon and PAH concentrations in all species of finfish, including migratory salmon and sea trout, remained low throughout the incident. Following the Braer incident, it was observed that PAH levels in individual sandeels, did not differ between samples taken from sites differing in exposure levels. This is presumed to indicate that the rate of metabolism is sufficient to control the accumulation of these substances in fish. Observations on sea bass following the Sea Empress oil tanker spill, showed that in the first year sea bass recruitment was reduced, however, this impact was short lived with recruitment returning to original levels the following year. Similarly, overall sandeel densities a year after the Braer incident, were found to have returned to pre-spill densities. In both instances, the finfish fisheries were reopened before the shellfish fisheries.

Following the Braer incident, some shellfish (particularly crustaceans) were found to lose hydrocarbons from their tissue as quickly as finfish, while others (molluscs) lose their accumulated hydrocarbons much more slowly (Topping *et al*., 1997). Crabs and lobsters retained significant levels of contamination (up to 225 µg/kg) for a longer period, while molluscs were found to accumulate the highest concentrations of PAHs e.g. levels detected in some scallop gonads were up to 20,000 µg/kg wet weight. Lower concentrations were seen in whelks, which are likely to be a result of the fact that they are carnivores rather than filter feeders, the latter ingesting dispersed oil droplets directly.

Following the Exxon Valdez spill in 1989, fish embryos and larvae were chronically exposed to partially weathered oil in dispersed forms, that accelerate dissolution of 3, 4- and 5-ringed hydrocarbons. Laboratory experiments showed that these multiringed PAHs from partially weathered oil at concentrations as low as 1 ppb, are toxic to pink salmon eggs exposed for the months of development and to herring eggs exposed for 16 days (Peterson *et al.* (2003) and references therein). This process explains the elevated mortality of incubating pink salmon eggs in oiled rearing streams, for at least 4 years after the oil spill (Bue *et al*., 1998). This long-term exposure had consequences for salmon and herring through indirect effects on growth, deformities, and behaviour with long term consequences on mortality and reproduction.

In conclusion, the Sea Empress, Braer oil and Exxon Valdez oil spills did have adverse effects on the fish and shellfish communities, in the areas of the oil spills. However, following a relatively short period, the finfish fisheries were reopened, with recruitment and densities of monitored stocks returning to pre-spill numbers a year later. Though fish stocks are expected to recover, a number of fish species spawn and have nurseries in the area that could be impacted by an oil spill (Section 3.4.4), such that the magnitude of the potential environmental effect of a well blowout on fish, is considered to be a significant. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

#### *11.2.2.4 Impact on marine mammals*

Marine mammals may be exposed to oil in one of two ways:

- Internally (swallowing contaminated water, consuming prey containing oil based chemicals, or inhaling of volatile oil related compounds); and
- Externally (swimming in oil or dispersants, or oil or dispersants on skin and body).

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

- Hypothermia due to conductance changes in skin;
- 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.

The nature of the oil and how much it has weathered, may also be an important factor in determining impacts on wildlife. Individuals oiled early in a spill, may be exposed to the more toxic components of the oil by direct contact and ingestion and suffer greater toxicity, than those affected by a more weathered oil.

There is little documented evidence of cetacean behaviour being affected by oil spills. Smultea and Wursig (1995) found that bottlenose dolphins apparently did not detect sheen oil and that although they detected slick oil, they did not avoid traveling through it. Evans (1982) observed that gray whales, *Eschrichtius robustus,* typically swam through oil seeps off California. Although the gray whales modified their swim speeds and breathing rates, there was no consistent pattern of behaviour regarding the presence of the oil. Lack of an olfactory system, likely contributes to the difficulty cetaceans have in detecting oil.

Within 24 hours of the Exxon Valdez spill (42 million litres of crude), killer whales (orca) were observed within the slick which was several hundred kilometres long. Travelling whales e.g. killer whales, may spend three to ten minutes at a time under water and when they surface to breathe, they may have travelled hundreds of metres. 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 oil-free water (Matkin *et al*., 2008). In the months following the Exxon Valdez spill, there were numerous observations of gray whales, harbour porpoises, Dall's porpoises and killer whales swimming through light to heavy crude oil sheens (Harvey and Dahlheim, 1994).

There is a growing body of evidence from the Gulf of Mexico in the aftermath of the Deepwater Horizon (DWH) oil spill. Bottlenose dolphins, *Tursiops truncates,* in the northern Gulf of Mexico, have shown depressed reproductive success rates (Kellar *et al*., 2017) and increased incidence of adrenal gland and lung lesions (Venn-Watson *et al*., 2015). Bottlenose dolphins from Barataria Bay, Louisiana showed a consistent change in immune function (increase in T and B lymphocyte proliferation), compared to dolphins unaffected by the DWH spill in Sarasota Bay, Florida. These changes are compatible with those documented in other species, following exposure to oil or PAHs. Changes in these cell functions are compatible with an increase in bacterial infections caused by Brucella, and are compatible with an increase in bacterial pneumonia (De Guise *et al*., 2017).

The way a cetacean consumes its food, affects the likelihood of it ingesting oil. Baleen whales which skim the surface, are more likely to ingest oil than "gulp feeders" or toothed whales. Baleen whales are particularly vulnerable to oil while feeding, as oil may stick to the baleen while the whales "filter feed" near oil slicks. Geraci and St. Aubins (1990) estimated that a long-finned pilot whale *Globicephala melas,* would need to ingest 30 l of oil over a period of weeks in order to suffer severe effects. Chronic ingestion of subtoxic quantities of oil, may have subtle effects which would only become apparent through long-term monitoring. The transfer of petroleum hydrocarbons through the mother's milk to suckling young, is another way oil affects cetaceans.

Cetaceans have mostly smooth skins with limited areas of pelage (hair covered skin) or rough surfaces. Oil tends to adhere to rough surfaces, hair or calluses of animals, so contact with oil by cetaceans, may cause only minor oil adherence.

Cetaceans can be susceptible to inhaling oil and oil vapour. This is most likely to occur when they surface to breathe. Several days after the Exxon Valdez spill, gray whales were observed swimming lethargically at the surface, and oil fumes were recorded at an altitude of 200 m (references within Matkin *et al*., 2008). Inhaling oil and oil vapour, may lead to damaging of the airways, lung ailments, mucous membrane damage or even death. A stressed or panicking dolphin tends to move faster, breathe more rapidly and surface more frequently into oil, resulting in increased exposure. Following the Exxon Valdez spill, a coated Dall's porpoise was observed to be stressed, and remaining at the surface for extended periods of time (Harvey and Dahlheim, 1994).

Seals are very 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 oil slicks during a number of documented spills (Geraci and St. Aubins, 1990). Most pinnipeds scratch themselves vigorously with their flippers but do not lick or groom themselves, so are less likely to ingest oil from skin surfaces. However, a pinniped mother trying to clean an oiled pup may ingest oil. The risk of oiling increases for pinniped pups. They spend much of their time in rocky shore areas and tidal pools, where spilt oil can accumulate. Recent evidence suggests that pinniped pups are very vulnerable during oil spills, because the mother/pup bond is affected by the odour and pinnipeds use smells to identify their young. If the mother cannot identify its pup by smell in a large colony it may not feed the pup, and this leads to abandonment and starvation.

Oil can impact on the mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, anal and urogenital orifices of seals. This can cause corneal abrasions, conjunctivitis and ulcers. Consumption of oil-contaminated prey, will lead to the accumulation of hydrocarbons in tissues and organs. Spraker *et al*. (1994) found four types of lesions characteristic of hydrocarbon toxicity in the brains, principally the thalamus, in oiled seals collected months after the Exxon Valdez spill.

Given the occurrence of marine mammals in the area impacted (Section 3.4.5) and their protected status, the magnitude of the potential environmental effect of a well blowout on marine mammals, is considered to be significant. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

#### *11.2.2.5 Impacts on seabirds*

The area over which a visible surface sheen with a thickness > 0.3 μm is predicted to extend, would be large (Figure 11-3). As discussed in Section 11.2.1.2, a sheen thickness > 0.3 μm is the minimum thickness expected to produce negative impacts on sea life encountering oil at the sea surface.

Birds are vulnerable to oiling from surface oil pollution, which can cause direct toxicity through ingestion and hypothermia, as a result of a bird's inability to waterproof their feathers. Oil pollution can also impact birds indirectly, through contamination of their prey. Seabird species vary greatly in their responses and vulnerability to surface pollution, therefore in assessing their vulnerability, it is important to consider species-specific aspects of their feeding, breeding and population ecology (White *et al*., 2001).

Species that spend a greater proportion of their time on the sea surface, are considered to be more at risk from the effects of surface pollution; for example, auk species (e.g. guillemot, razorbill, little auk and puffin) are more likely to be affected than the highly aerial petrels. Species that are wholly dependent on the marine environment for feeding and resting (e.g. procellarids such as northern fulmar), are considered more vulnerable to the effects of surface pollution than species that use offshore areas only seasonally, or move offshore only to rest or roost. Additionally, the potential reproductive rate of a species, will influence the time taken for a population to recover following a decline. Other factors, such as mortality and migration rates, species abundance and conservation status (e.g. globally threatened), shall also determine the effects of an oil spill on seabird populations.

With such large quantities of oil released, transient surface sheens can be expected for several weeks after the spill has ceased, and oil will continue to be released from any affected shorelines.

The sensitivity of birds to surface oil pollution in the vicinity of the proposed CNDT location, is considered low throughout most of the year (Section 3.4.3). However, the extent of surface oiling during a blowout, could impact adjacent areas where seabird sensitivity is considered high and very high in September and October, depending on the timing of the spill. Given the wide area impacted, the magnitude of the potential environmental effect of a well blowout on seabirds, is considered to be significant. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

#### *11.2.2.6 Impact on offshore protected areas*

A number of offshore protected areas could be affected by hydrocarbons released as a result of a well blowout, at the CNDT location (Section 3.5).

Toxic water column and surface concentrations are expected within other offshore designated sites, such that some of the designated features may be impacted e.g. birds feeding in the Outer Firth of Forth and St Andrews Bay Complex pSPA. Due to the potential impact on the designated features of offshore sites, the potential environmental effect of a well blowout on offshore protected areas, is considered to be significant. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

#### *11.2.2.7 Impact on the coast including protected areas*

Stochastic modelling results show that there is a possibility (< 17 %) of oil beaching on shorelines in the UK, Denmark, Norway and Sweden, but that probabilities are relatively low.

Deterministic modelling of the spill scenario resulting in the highest volume of beached oil, predicted that the highest concentrations of oil, arriving on the coast of North East England, could be as high as 2.26 kg/m$^2$ (moderate oiling), although most oiling is moderate to light.

Concentrations > 100 g/m$^2$ is considered to be an impact threshold for oiling of birds by the US Army Corps of Engineers (2003), and is reinforced by McCay (2009) who notes that 100 g/m$^2$ would be enough to coat benthic epifaunal invertebrates, living on hard substrates in intertidal habitats, thus compromising the animals. It is also inferred from the level of ‘light’ oiling defined by ITOPF Technical Information Paper 6 (ITOPF, 2014). Figure 11-6 illustrates the areas where shoreline oiling exceeds this impact threshold, for the deterministic model.

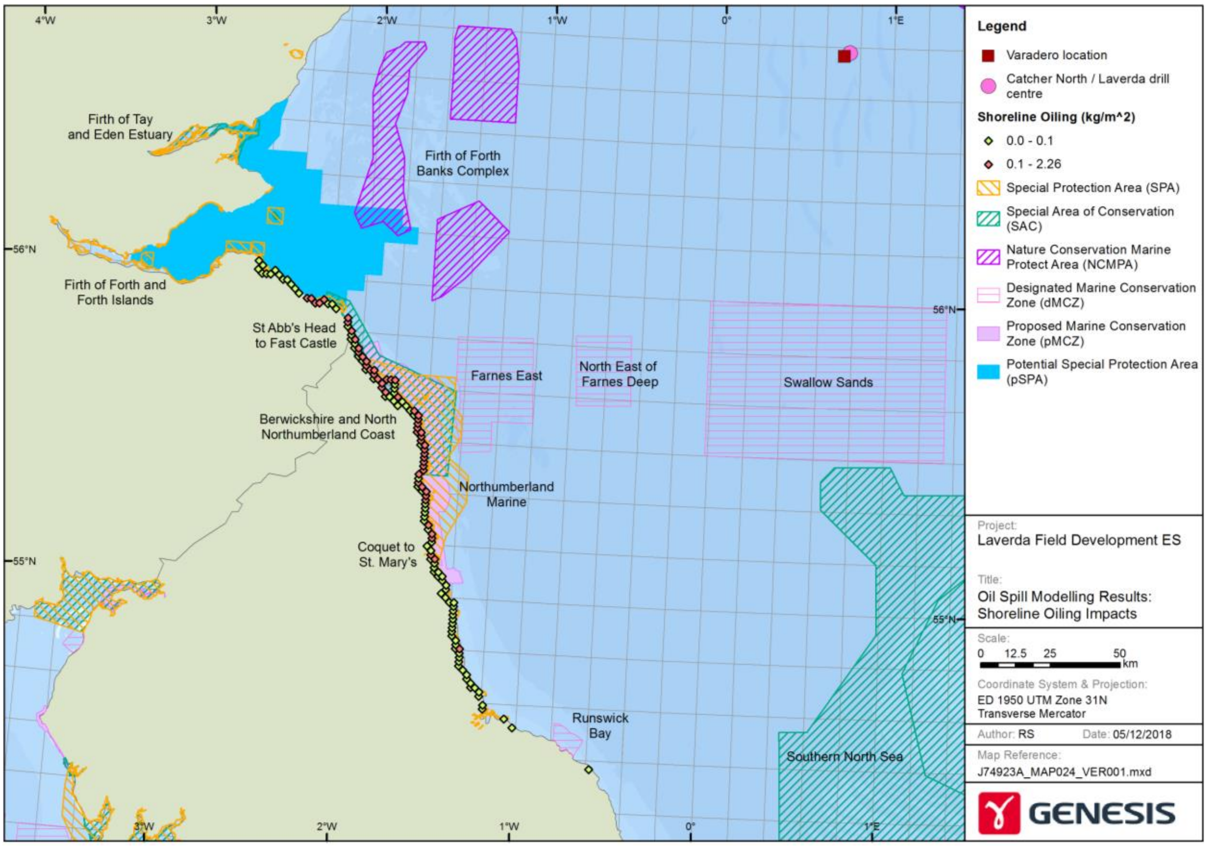



**Figure 11-6 Shoreline impacts and protected sites (deterministic modelling).**

Due to the potential for oil beach at designated areas, the magnitude of effect of a well blowout on the coast and coastal protected areas, is considered to be major. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

### *11.2.2.8 Impact on aquaculture and shellfish waters*

Modelling results show that there is a possibility of contamination of the water column close to 25 ppb from a worst case blowout, near designated shellfish waters and a shellfish farm in the Lindisfarne area of the coast of North East England (Figure 11-7). Although relatively low, these concentrations could lead to an accumulation of hydrocarbons in shellfish tissues resulting in tainting, making them unmarketable. Therefore, the magnitude of effect of a well blowout on aquaculture and shellfish waters, is considered to be significant. Section 11.2.3 considers the overall environmental risk of a blowout, when the impact on all receptors as a whole is considered.

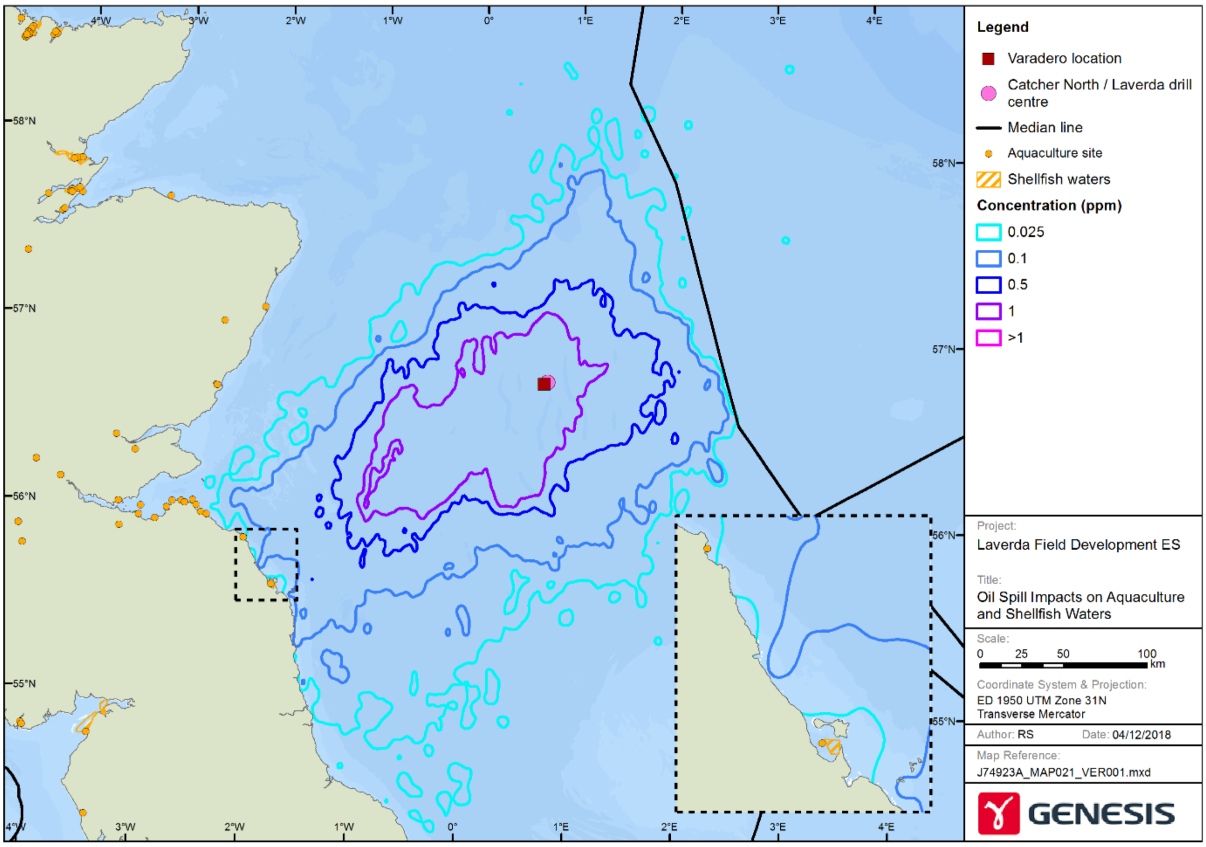



**Figure 11-7 Aquaculture, shellfish waters and maximum accumulated water column oil concentrations (deterministic modelling).**

### 11.2.3 Summary of Impact and Overall Risk to Receptors

Table 11-3 summarises the magnitude of the potential environmental effect of a well blowout, at the CNDT location on the receptors considered.

**Table 11-3 Summary of effects on environmental receptors.**

| Receptor | Magnitude of Environmental Effects |
|---|---|
| Plankton | Minor |
| Benthic animals | Significant |
| Fish | Minor |
| Marine mammals | Significant |
| Seabirds | Significant |
| Offshore protected areas | Significant |
| Coast and coastal protected areas | Major |
| Aquaculture and shellfish waters | Significant |

When all receptors are taken into account, the magnitude of the environmental effect is considered to be major.

Following the application of control and mitigation measures, the blowout frequency for development drilling of an oil well in the North Sea is 4.8 x $10^{-5}$ (or 4.8 blowouts for every 10,000 drilling operations) and therefore the likelihood of such an event is considered to be remote.

The overall environmental risk of a well blowout, is therefore considered **High**, however given the low likelihood, it is considered tolerable through management under the mitigation measures described in Section 11.7.

## 11.3 Decommissioning Phase

During decommissioning activities, the impact of any accidental events are anticipated to be within the impacts discussed above.

## 11.4 Transboundary Effects

Of the accidental events discussed, a well blowout and a loss of fuel inventory from the rig, are expected to result in transboundary effects. Stochastic modelling suggests that the probability of crossing different median lines and the time to cross them varies, depending on the time of year and the hydrocarbon release scenario, as described in Table 11-4.

**Table 11-4 Time for hydrocarbons to cross median lines following a well blowout (POUK, 2016b).**

| Median Line | Dec – Feb | Mar – May | Jun – Aug | Sep – Nov |
|---|---|---|---|---|
| UK / Norway | 2 days<br>100 % | 3 days<br>Up to 97 % | 5 days<br>100 % | 3 days<br>100 % |
| UK / Denmark | 8 days<br>Up to 91 % | 10 to 14 days<br>Up to 62 % | 10 to 14 days<br>Up to 92 % | 9 days<br>Up to 96 % |
| UK / Sweden | 25 to 30 days<br>Up to 7 % | >30 days<br>Up to 12 % | >30 days<br>Up to 13 % | 25 to 30 days<br>Up to 6 % |
| UK / Germany | 9 days<br>Up to 88 % | 10 to 14 days<br>Up to 54 % | 17 to 20 days<br>Up to 84 % | 9 days<br>Up to 92 % |
| UK / Netherlands | 9 days<br>Up to 86 % | 20 to 25 days<br>Up to 47 % | 17 to 20 days<br>Up to 83 % | 10 to 14 days<br>Up to 86 % |

## 11.5 Natural Disasters

Some natural disasters could increase the risk of a major pollution event occurring at the proposed Laverda Field Development. For example, an earthquake could lead to damage to the subsea infrastructure and potential loss of well control. The likelihood of an earthquake of sufficient magnitude on the UKCS to impact seabed infrastructure is extremely remote.

Climate change effects, such as sea level change and extreme weather events, are not considered to alter significantly the range of effects considered. Extreme weather may make accidents to the drilling rig more likely. However the rig has procedures in place for making safe and shutting down operations during extreme weather, along with emergency procedures in the case of rig damage. A full loss of drilling rig fuel inventory was also considered in the Varadero TOOPEP (POUK, 2016b).

## 11.6 Major Environmental Incident Assessment

The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015 (SCR 2015) apply to oil and gas operations on the UKCS. The primary aim of SCR 2015, is to reduce the risks from Major Accident Hazards (MAHs) to the health and safety of the workforce employed on offshore installations, or in connected activities. The Regulations also aim to increase the protection of the marine environment and coastal economies against pollution, and ensure improved response mechanisms in the event of such an incident.

The potential for a Major Environmental Incident (MEI) must be assessed as part of the MAH, and a description of the results must be included within the Safety Case. An MAH could be a fire, explosion, loss of well control or the release of a dangerous substance that results in loss of life. A MEI is the outcome of a MAH, which is likely to result in significant adverse effects on the environment.

Of the accidental events identified, only a loss of well control is expected to potentially lead to an MEI. This is driven by the potential impacts on coastal protected sites, which could be significantly affected by hydrocarbon pollution and would constitute an MEI in accordance with the OSD definitions. However, as mentioned previously, the likelihood of such an event is considered remote.

It should be noted that the modelled scenario presented here is based on a total release volume of 238,288 $m^3$. which is around 38 % greater than the maximum volume expected to be released at Laverda (145,878 $m^3$).

## 11.7 Mitigation Measures

The mitigation measures associated with preventing a well blowout are summarised here.

**Proposed Control Measures**

- Activities will be carried out by trained and competent offshore crews and supervisory teams;
- An approved TOOPEP and OPEP will be in place prior to any activities being undertaken;
- Records will be kept of oil spill training and exercises as required by the TOOPEP and OPEP;
- A co-ordinated industry oil spill response capability will be available;
- Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue for POUK personnel;

Wells specific control measures:

- A robust BOP pressure and functional testing regime will be in place;
- Routine Remotely Operated Vehicle (ROV) inspections of the BOP on the seabed will be performed, as well as visual integrity checks whenever BOPs are recovered to the surface;
- Appropriate mud weights will be used to ensure well control is maintained;
- A contract will be in place with a well capping advice provider, in case of emergency;

Operations-specific control measures:

- Pipelines will be protected by pressure alarms and a leak detection system; and
- Oil spill control measures will be followed as outlined in the TOOPEP and OPEP.

Applying the risk assessment methodology described in Section 4, six accidental events were identified to have a **Medium** significance risk and are acceptable once managed under the mitigation measures identified. One accidental event, a subsea well blowout, was considered a **High** risk due to the magnitude of the effect on the different receptors, rather than the likelihood which is considered remote. Given the preventative measures in place to reduce the likelihood of a spill, and the response resources and procedures that will be in place in the event of a spill, the overall residual environmental risks posed by the proposed drilling operations, are deemed to have been reduced to an acceptable level.

# 12 CONCLUSION

A detailed assessment of the potential environmental impacts associated with the proposed Laverda Field Development Project has been carried out. The identification of the potential impacts is based on the nature of the proposed activities and was informed by available literature and guidance documents, industry specific experience and consultation with BEIS and their advisors. The commitments made in this ES will be incorporated into environmental management plans for the drilling, installation and operations phases of the development.

## 12.1 Environmental Effects

The development area is located in the CNS in a mature oil and gas province.

The potential impacts to the environment from all phases of the project were identifed. The environmental aspects of each of the key activities, for each phase of the development, were identified and quantified in terms of their duration (or likelihood with regards to accidental events) and the magnitude of effect. In the case of planned activities, the results were assessed on the basis of the significance of the impact posed to the environment and were summarised as being either low, medium or high. Potential unplanned (or accidental events) were assessed in terms of the environmental risk and were also summarised in terms of being low, medium or high.

The assessment showed that, after implementation of mitigation measures, the significance of impact of all of the planned activities is either low or medium (Appendix B). Table 12-1 identifies those activities found to be of Medium significance. In each case, the magnitude of effect for planned activities ranged between negligible and moderate, with no effects considered to be major, or severe, following application of mitigation and control measures.

The risk of six unplanned events was considered to be of medium significance and one, a well blowout, was considered to be of high significance. From Table 12-1, it can be seen that those accidental events of medium risk, had magnitude of effects associated with them that ranged from slight to significant, with none of the anticipated effects considered to be of a major, or severe, significance. Only the well blowout is considered to have a severe magnitude of effect.

**Table 12-1: Activities identified to have a medium or high significance of impact/risk.**

| Aspect | Activity | Magnitude of effect | Duration/ Likelihood | Significance of impact/risk |
|---|---|---|---|---|
| **Physical presence** | Physical presence of all subsea infrastructure (includes well, flowlines, EHC umbilical, tie-in spools, rock dump, mattresses, grout bags etc.). | Minor | 5 | Medium |
| **Emissions to air** | Exhaust emissions associated with the HDJU drilling rig | Minor | 4 | Medium |
| **Discharges to sea** | Planned discharge to sea of WBM and WBM contaminated cuttings, brine, cement and completion chemicals required in the drilling process. | Moderate | 3 | Medium |
| **Seabed disturbance** | Impacts of spud cans/anchors/anchor chains on the seabed during positioning of rig | Minor | 4 | Medium |
| | Disturbance associated with installation of subsea infrastructure. | Moderate | 4 | Medium |
| **Underwater noise** | General vessel use. | Minor | 4 | Medium |
| | Drilling operations. | Minor | 4 | Medium |
| **Waste** | General vessel waste. | Moderate | 4 | Medium |
| | Wastes generated by the HDJU drilling rig during routine operations. | Moderate | 4 | Medium |
| | OBM mud and OBM contaminated cuttings. | Moderate | 4 | Medium |
| **Unplanned / accidental events** | Minor chemical / hydrocarbon release from vessels e.g. from drains on vessels or the HDJU drilling rig. | Slight | 5 | Medium |
| | Major oil / chemical (e.g. fuel oil and diesel) release (potentially due to vessel collision or loss of fuel inventory from drilling rig). | Significant | 2 | Medium |
| | Dropped objects from vessels or drilling rig resulting in damage to subsea infrastructure and seabed. | Minor | 4 | Medium |
| | Flare drop out – during well bore clean up and well testing. | Slight | 5 | Medium |
| | Loss of containment of OBM (potentially through a burst hose) resulting in a release to sea. | Slight | 5 | Medium |
| | Well blowout (uncontrolled hydrocarbon release in the event of loss of well control). | Severe | 2 | High |

## 12.2 Minimising Environmental Impact

The execution of the proposed Laverda Field Development Project, when incorporating the control measures identified in this ES, is not expected to have a significant impact on the environment. Following implementation of identified control measures, all residual risks to the environment are considered to be As Low As Reasonable Practicable (ALARP).

Routine atmospheric emissions and discharges to sea, would be expected to disperse within a limited distance from the development. It is therefore unlikely that planned emissions and discharges will have a transboundary impact, given that the nearest median line (UK/Norway median line) is *c*. 104 km from the proposed development. Hence, no significant transboundary impacts were identified as a result of planned activities. There is a risk of transboundary impacts associated with an accidental spill/release of oil, as discussed in Section 11. However measures will be in place to minimise the likelihood of such an event occurring. Should an uncontrolled release occur, there will also be measures in place to ensure a co-ordinated and co-operative well control and pollution response campaign (Section 11).

## 12.3 Commitments

Project specific commitments and mitigation measures to minimise the impact of the proposed Laverda Field Development Project on the environment, have been highlighted throughout the ES and are summarised in Table 12-2. These will be captured in the project environmental management plan, which includes roles and responsibilities for their implementation.

**Table 12-2: Laverda Field Development project commitments.**

| Aspect | Commitments |
|---|---|
| **Physical presence** | • Ongoing consultation with SFF;<br>• Notice to Mariners will be circulated prior to rig mobilisation;<br>• Notice will be sent to the NLB of any drilling rig moves and vessel mobilisation associated with the mobilisation and demobilisation of the HDJU drilling rig;<br>• The HDJU drilling rig will abide by CtL conditions;<br>• A Collision Risk Management Plan will be produced;<br>• All vessels will adhere to COLREGS and will be equipped with navigational aids, including radar, lighting and AIS (Automatic Identification System) etc.;<br>• The HDJU drilling rig will be equipped with navigational aids and aviation obstruction lights system, as per the Standard Marking Schedule for Offshore Installations;<br>• Vessel use will be optimised by minimising the number of vessels required and length of time vessels are on site;<br>• Flowlines will be designed in accordance with industry standards;<br>• A 500 m exclusion zone will be applied for at the CNDT location;<br>• The use of pipeline stabilisation features (e.g. mattresses, rock cover and grout bags) will be minimised through project design and will be used in accordance with SFF preferred practice.<br>• Size of rock and rock cover profiles will be in accordance with industry best practices. |

| Aspect | Commitments |
|---|---|
| **Emissions to air** | • The HDJU drilling rig will be subject to audits ensuring compliance with UK legislation;<br>• The impact from vessel emissions will be mitigated by optimising support vessel efficiency and minimising duration of activity;<br>• During drilling there will be adherence to good operating practices and maintenance programmes;<br>As Licensee, POUK will monitor and perform audits of BW Catcher to ensure:<br>• Emissions from combustion equipment are regulated through EU ETS and PPC Regulations. As part of the PPC permit the following measures will be in place:<br>• During production there will be adherence to good operating practices, maintenance programmes;<br>• The emissions from the combustion equipment will be monitored;<br>• Plant and equipment will be subject to an inspection and energy maintenance strategy;<br>• UK and EU air quality standards are not exceeded;<br>• Fuel gas usage will be monitored; and<br>• Energy assessments will be carried out as required. |
| **Discharges to sea** | • The HDJU drilling rig will be subject to audits ensuring compliance with UK legislation;<br>• All vessels used will be MARPOL compliant;<br>• Where technically feasible POUK will prioritise the selection of PLONOR, or chemicals with a lower RQ;<br>• The base case is for PW reinjection (reaching a minimum target of 95 % availability); and<br>• The discharges of PW and associated chemicals are regulated by the OPPC and OCR regulations and reported through the Environmental Emissions Monitoring Scheme (EEMS). During abnormal operations, PW sampling, analysis and reporting will be undertaken in line with the regulations and permit conditions. |
| **Seabed disturbance** | • Pre-deployment surveys will be undertaken to identify suitable locations for the drilling rig anchors;<br>• Use of dynamically positioned vessels; and<br>• The use of mattresses, rockdump and grout bags will be minimised through optimal project design. |
| **Underwater noise** | • Optimise duration of drilling and installation activities.<br>• No specific mitigation measures are recommended for the pipelay, drilling and vessel operations associated with the proposed project beyond good maintenance of equipment to reduce sound levels. |
| **Waste** | • POUK will apply the principles of the Waste Management Hierarchy during all activities i.e. Reduce, Reuse, Recycle; |

| Aspect | Commitments |
|---|---|
| | • Existing asset and vessel WMPs will be followed;<br>• Only permitted disposal yards/landfill sites will be used. |
| **Accidental events** | • Activities will be carried out by trained and competent offshore crews and supervisory teams;<br>• An approved TOOPEP and OPEP will be in place prior to any activities being undertaken;<br>• Records will be kept of oil spill training and exercises as required by the TOOPEP and OPEP;<br>• A co-ordinated industry oil spill response capability will be available;<br>• Enhanced sharing of industry best practices via the Oil Spill Response Forum (OSRF) will continue for POUK personnel;<br>Wells specific control measures:<br>• A robust BOP pressure and functional testing regime will be in place;<br>• Routine Remotely Operated Vehicle (ROV) inspections of the BOP on the seabed will be performed, as well as visual integrity checks whenever BOPs are recovered to the surface will be undertaken;<br>• Appropriate mud weights will be used to ensure well control is maintained;<br>• A contract will be in place with a well capping advice provider, in case of emergency;<br>Operations-specific control measures:<br>• Pipelines will be protected by pressure alarms and a leak detection system; and<br>• Oil spill control measures will be followed as outlined in the TOOPEP and OPEP. |

## 12.4 Overall Conclusion

POUK on behalf of itself and its Co-Venturers, is proposing to develop the Laverda Field located, *c*. 165 km south-east of Aberdeen within the CNS. The hydrocarbon reservoirs of the proposed Laverda Field Development Project are well understood (based on the industry's history of drilling and field development in this area of the North Sea) and will be developed using proven technology incorporating current best practices and latest generation equipment. A robust design, strong operating practices and a highly trained workforce will ensure the proposed Development does not result in any significant long-term environmental impacts, or cumulative or transboundary effects. Additional measures will also be in place during the operating phase, to effectively respond to potential emergency scenarios.

In summary, incremental production from the Laverda Field will be used to fill FPSO ullage and reduce the rate of production decline using the existing capacity of the BW Catcher FPSO. As a result, no significant incremental environmental impacts are anticipated.

The ES assesses the worst case impact of the project on the environment and is therefore very conservative. Applying the mitigation measures identified, it is the conclusion of this ES that the current proposal for the Laverda Field Development can be completed without causing any significant long term environmental impacts, or cumulative and transboundary effects.

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# APPENDIX A

## A.1 Scotland's National Marine Plan

Scotland's NMP (Marine Scotland, 2015) covers the management of both Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles). The aim of the NMP is to help ensure the sustainable development of the marine area, through informing and guiding regulation, management, use and protection of the NMP areas. The Laverda Field Development activities have been assessed against each of the 21 NMP objectives, details of which can be found in Table A-1.

**Table A-1: The proposed Laverda Field Development Assessed Against Scotland's NMP principles.**

| Scotland's NMP Principle Number | Applicable? | Assessment against Principle |
|---|---|---|
| GEN 1 General planning principle | | |
| There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of this Plan. | ✓ | The Laverda Field Development is a tieback to existing infrastructure. The EIA assesses potential impacts to the environment and to other sea users. |
| GEN 2 Economic benefit | | |
| Sustainable development and use which provides economic benefit to Scottish communities is encouraged when consistent with the objectives and policies of this Plan. | ✓ | The Laverda Field Development will provide jobs and tax revenues to the Scottish economy. |
| GEN 3 Social benefit | | |
| Sustainable development and use which provides social benefits is encouraged when consistent with the objectives and policies of this Plan. | ✓ | The Laverda EIA considers impacts to other sea users in decision making e.g. fisheries and pipelines. |
| GEN 4 Co-existence | | |
| Proposals which enable coexistence with other development sectors and activities within the Scottish marine area are encouraged in planning and decision making processes, when consistent with policies and objectives of this Plan. | ✓ | Tie-back to existing infrastructure. Minimising infrastructure footprint. Consult other sea users e.g. fisheries and other oil and gas operators. |
| GEN 5 Climate change | | |
| Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change. | ✓ | Fuel use associated with vessel movements and the drilling rig as well as flaring for well clean up and testing will be minimised as far as possible. |
| GEN 6 Historic environment | | |
| Development and use of the marine environment should protect and, where appropriate, enhance heritage assets in a manner proportionate to their significance. | ✓ | Extensive surveys of The Catcher Area Development. Nearest wreck identified is c. 4.4 km from proposed drilling location. |
| GEN 7 Landscape/seascape | | |
| Marine planners and decision makers should ensure that development and use of the marine environment take seascape, landscape and visual impacts into account | × | Subsea Development |
| GEN 8 Coastal process and flooding | | |
| Developments and activities in the marine environment should be resilient to coastal change and flooding, and not have unacceptable adverse impact on coastal processes or contribute to coastal flooding. | × | Offshore Development |

| Scotland's NMP Principle Number | Applicable? | Assessment against Principle |
|---|---|---|
| GEN 9 Natural heritage | | |
| Development and use of the marine environment must:<br>a) Comply with legal requirements for protected areas and protected species.<br>b) Not result in significant impact on the national status of Priority Marine Features.<br>c) Protect and, where appropriate, enhance the health of the marine area. | ✓ | Environmental surveys undertaken in the region of the Catcher Area Development. Design and installation method of the subsea infrastructure informed by these surveys. |
| GEN 10 Invasive non-native species | | |
| Opportunities to reduce the introduction of invasive non-native species to a minimum or proactively improve the practice of existing activity should be taken when decisions are being made. | ✓ | All vessels will follow IMO regulations. All vessels, including the drilling rig, will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award. |
| GEN 11 Marine litter | | |
| Developers, users and those accessing the marine environment must take measures to address marine litter where appropriate. Reduction of litter must be taken into account by decision makers. | ✓ | Contractor management plans will be in place. All vessels will follow IMO requirements. |
| GEN 12 Water quality and resource | | |
| Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive, Marine Strategy Framework Directive or other related Directives apply. | ✓ | Discharges to sea have been identified and assessed. Laverda will not result in the deterioration of water quality in the area. |
| GEN 13 Noise | | |
| Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects. | ✓ | No significant sources of marine noise identified. The appropriate mitigation measures will be adopted in relation to vessel and drilling rig noise. |
| GEN 14 Air quality | | |
| Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits. | ✓ | Emissions to air quantified in the EIA. Assessment concludes that they will present a low environmental risk to air quality, the duration of which will be minimised as far as possible. |
| GEN 15 Planning alignment A | | |
| Marine and terrestrial plans should align to support marine and land-based components required by development and seek to facilitate appropriate access to the shore and sea. | × | Offshore tieback to existing infrastructure. |
| GEN 16 Planning alignment B | | |
| Marine plans should align and comply where possible with other statutory plans and should consider objectives and policies of relevant non-statutory plans where appropriate to do so. | × | Applies to inshore waters only. |
| GEN 17 Fairness | | |
| All marine interests will be treated with fairness and in a transparent manner when decisions are being made in the marine environment. | × | Competent Authority responsibility. |
| GEN 18 Engagement | | |
| Early and effective engagement should be undertaken with the general public and all interested stakeholders to facilitate planning and consenting processes. | ✓ | The Laverda ES is subject to public and informal consultations. |
| GEN 19 Sound evidence | | |

| Scotland's NMP Principle Number | Applicable? | Assessment against Principle |
|---|---|---|
| Decision making in the marine environment will be based on sound scientific and socio–economic evidence. | ✓ | Environmental Baseline prepared with reference to available literature and site-specific survey data. |
| GEN 20 Adaptive management | | |
| Adaptive management practices should take account of new data and information in decision making, informing future decisions and future iterations of policy. | ✓ | POUK's decision making takes into account best understanding of the marine environment through surveys and using latest available scientific data. |
| GEN 21 Cumulative impacts | | |
| Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation. | ✓ | Cumulative impacts considered in the Laverda ES and are considered proportionate to the size of the development. |

## A.2 Marine Strategy Framework Directive (MSFD)

The aim of the European Union's Marine Strategy Framework Directive (MSFD) is to protect more effectively the marine environment across Europe. The MSFD outlines a transparent, legislative framework for an ecosystem-based approach to the management of human activities, which supports the sustainable use of marine goods and services. The overarching goal of the Directive, is to achieve 'Good Environmental Status' (GES) by 2020 across Europe's marine environment.

The MSFD does not state a specific programme of measures that Member States should adopt to achieve GES, except for the establishment of MPAs. The MSFD does however outline 11 high level descriptors of GES in Annex I of the Directive. The Laverda Field Development activities have been assessed against each of the GES descriptors, details of which can be found in Table A-2.

**Table A-2 The proposed Laverda Field Development assessed against the MSFD Good Environmental Status descriptors.**

| Marine Strategy Framework Directive: Good Environmental Status Objectives | Applicable? | Assessment Against Objective |
|---|---|---|
| GES 1 | | |
| Biological diversity is maintained and recovered where appropriate. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions. | ✓ | Linked to GEN 9. Environmental surveys undertaken in the Laverda area. Design and installation method of the subsea infrastructure informed by these surveys. |
| GES 2 | | |
| Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems. | ✓ | Linked to GEN 10. All vessels will follow IMO regulations. All vessels, including drilling rig, will be regulatory compliant, e.g. the International Convention for the Control and Management of Ships' Ballast Water and Sediments, and subject to audit prior to contract award. |
| GES 3 | | |
| Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock. | ✓ | Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure informed by these surveys. |
| GES 4 | | |
| All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity. | ✓ | Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure informed by these surveys. |
| GES 5 | | |
| Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters. | ✓ | Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure informed by these surveys. |
| GES 6 | | |
| Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected. | ✓ | Linked to GEN 9. Environmental surveys undertaken in the project area. Design and installation method of the subsea infrastructure informed by these surveys. |
| GES 7 | | |
| Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems. | ✓ | Linked to GEN 12. Seabed disturbance and potential impact on marine ecosystems assessed in EIA. |
| GES 8 | | |
| Concentrations of contaminants are at a levels not giving rise to pollution effects. | ✓ | Linked to GEN 12. Laverda will not result in the deterioration of water quality in the area. |
| GES 9 | | |
| Contaminants in fish and other seafood for human consumption do not exceed levels established by Community legislation or other relevant standards. | ✓ | Linked to GEN 12. Laverda will not result in the deterioration of water quality in the area. |
| GES 10 | | |
| Properties and quantities of marine litter do not cause harm to the coastal and marine environment. | ✓ | Linked to GEN 11. Contractor management plans will be in place. All vessels will follow IMO requirements. |
| GES 11 | | |
| Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment. | ✓ | Linked to GEN 13. No significant marine noise sources identified. The appropriate mitigation measures will be adopted. |

## A.3 Oil and Gas Marine Planning Policies

Objectives and policies for the Oil and Gas sector, should be read subject to those set out in the NMP and the MSFD. It is recognised that not all of the objectives can necessarily be achieved directly through the marine planning system, but they are considered important context for planning and decision making. The Laverda Field Development activities have been assessed against the six oil and gas marine planning policies, details of which can found in Table A-3.

**Table A-3 The proposed Laverda Field Development assessed against the Oil and Gas Marine Planning Policies.**

| Oil and Gas Marine Planning Policies | Applicable? | Assessment against Policy |
|---|---|---|
| Oil & Gas 1 | | |
| The Scottish Government will work with BEIS, the new Oil and Gas Authority and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of BAT and BEP. Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change. | ✓ | Environmental risks addressed/assessed in the EIA. |
| Oil & Gas 2 | | |
| Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process. | × | Laverda is a new subsea development tied back to existing topsides facilities. |
| Oil & Gas 3 | | |
| Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints. | ✓ | Laverda will be an offshore subsea development. Seabed disturbance and physical presence of the infrastructure have been assessed. |
| Oil & Gas 4 | | |
| All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance. | × | Laverda will be a subsea development. |
| Oil & Gas 5 | | |
| Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions. | ✓ | Laverda will be incorporated into the existing BW Catcher OPEP, POUK Onshore OPEP and BW Catcher Safety Case. A drilling TOOPEP will be in place during drilling operations. |
| Oil & Gas 6 | | |
| Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive. | ✓ | Laverda will be incorporated into the existing BW Catcher OPEP and POUK Onshore OPEP. A drilling TOOPEP will be in place during drilling operations. |

# APPENDIX B – ENVIRONMENTAL IMPACT ASSESSMENT

| Key | | |
|---|---|---|
| High | Medium | Low |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| **VESSELS: DRILLING, INSTALLATION AND COMMISSIONING** | | | | | | | |
| Physical presence of vessels | Vessel support e.g. for surveys, drilling and installation activities. | Navigation hazard, restriction of fishing operations, disturbance to birds / cetaceans. | - Kingfisher bulletin and notification to MOD prior to commencement of operations.<br>- Establishment of 500 m exclusion zone in advance of drilling activities.<br>- Optimised vessel use reducing vessel time spent in field. | P | 1 | 4 | L |
| Emissions to air | Exhaust emissions resulting from diesel combustion onboard vessels and helicopters for power generation. | Emissions to atmosphere ($CO_2$, CO, $SO_x$, $NO_x$ etc) resulting in a minor contribution to climate change, acidification and photochemical smog (compared with overall activity in the North Sea). | - Optimised use of vessels through efficient journey planning to minimise diesel combustion and emissions.<br>- Vessel CMID (Common Marine Inspection Documents) and HSE assurance audits conducted to ensure that contracted vessels meet IMO/MARPOL and POUK marine and HSE standards. | P | 1 | 4 | L |
| Discharges to sea | Discharge of domestic sewage and food waste from vessels. | Organic enrichment and local impacts on water quality (deoxygenation) and seabed sediments.<br>However, may have positive effect in that nutrients are provided for flora and fauna. | - Optimised vessel use reducing vessel time spent in field.<br>- Vessel CMID and HSE assurance audits conducted to ensure that contracted vessels meet IMO/MARPOL and POUK marine and HSE standards. | P | 1 | 4 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| Discharges to sea | Ballast/ drains water discharge. | Water quality in immediate vicinity of discharge may be reduced, but effects are usually minimised by rapid dilution in receiving body of water and non-continuous discharge.<br>Possible introduction of invasive species depending on vessel routes. | - Vessel CMID (Common Marine Inspection Documents) and HSE assurance audits conducted to ensure that contracted vessels meet IMO/MARPOL and POUK marine and HSE standards. | P | 1 | 4 | L |
| Noise and visual impact | General vessel noise from operations, including Dynamic Positioning (DP), generating elevated sound levels. | Noise from DP has the potential to cause short-term disturbance to marine mammals and fish in the form of temporary displacement from the area. Marine mammals and fish are expected to return once the vessel(s) have departed the area. | - Optimised vessel use reducing vessel time spent in field. | P | 2 | 4 | M |
| Waste | General operational hazardous and non-hazardous waste. | Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites. | - All wastes will be segregated and managed (reuse / recycling / treatment / disposal) in accordance with POUK waste hierarchy and regulatory requirements.<br>- Waste reports will be sent onshore for review and compliance monitoring.<br>- Vessels will conform with Waste Management Plan/Waste Record Book, as checked during vessel CMID/ HSE assurance audits.<br>- Vessels will be IMO/MARPOL compliant. | P | 3 | 4 | M |
| Use of resources | Diesel usage for power generation. | Resource use – energy use. | - Optimised use of vessels through efficient journey planning.<br>- Vessels will be IMO/MARPOL compliant. | P | 1 | 4 | L |
| Unplanned event | Release of helifuel to sea as a result of a helicopter ditch/crash during vessel transit. | Water quality deterioration, impact on marine flora and fauna. | - Managed under regional logistics services and Emergency Response documents including Field OPEP, as relevant.<br>- Assurance and auditing of contracted helicopter services to ensure compliance with relevant safety requirements. | U | 1 | 3 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| Unplanned event | Minor chemical / hydrocarbon release from vessels e.g. from drains. | Water quality deterioration, impact on marine flora and fauna. | - Emergency response plans will be in place, including vessel SOPEPs.<br>- Vessels will comply with applicable IMO/ MARPOL requirements.<br>- Simultaneous Operations (SIMOPS) will be managed through bridging documents and appropriate communications (e.g. if vessels are within the drill centre 500 m zone).<br>- COSHH and MSDS sheets will be available on the vessel.<br>- Standard operating procedures will be adhered to e.g. bunkering in good light, regular hose inspections, correct storage and segregation of chemicals etc.<br>- Dispersant and spray equipment on board ERRV for Tier 1 spill response.<br>- Kingfisher bulletins will be updated with vessel activities, as appropriate.<br>- Vessels shall abide with International Collision Regulations | U | 1 | 5 | M |
| Unplanned event | Major oil / chemical (e.g. fuel oil and diesel) release (potentially due to vessel collision). | Pollution of water column, Threat to biodiversity Harm to surrounding ecosystems, flora and fauna.<br>Fishing impact assessment has been completed with no significant risks identified. | - Emergency response plans will be in place, including vessel SOPEPs.<br>- Simultaneous Operations (SIMOPS) will be managed through bridging documents and appropriate communications (e.g. if vessels are within the drill centre 500 m zone).<br>- Vessels will comply with applicable IMO/ MARPOL requirements.<br>- COSHH and MSDS sheets will be available on the vessel.<br>- Kingfisher bulletins will be updated with vessel activities, as appropriate.<br>- Vessels shall abide with International Collision Regulations<br>- POUK subscribes to Oil Spill Response Limited and OPOL in the event of a Tier 2/3 event. | U | 2 | 3 | M |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| | | | - ERRV vessel will be located in field for Tier 1 response, as required. Dispersant and spray equipment available on board ERRV. | | | | |
| Unplanned Events | Dropped objects resulting in damage to subsea infrastructure and seabed. | Local water quality deterioration should existing pipeline be damaged. | - Vessels will follow Simultaneous Operations (SIMOP) plans and lifting procedures, which include assessment/risk of dropped objects.<br>- PON2 notification to be submitted in the event of a dropped object that is a potential hazard to other sea users.<br>- Dropped objects will be retrieved where practicable. | U | 1 | 4 | M |
| **DRILLING OPERATIONS** | | | | | | | |
| Physical presence of the HDJU drilling rig | Physical presence of the drilling rig at the project location (the ES assumes 75 days for the Laverda well). | Navigation hazard, restriction of fishing operations, disturbance to birds / cetaceans. | - Drilling rig moves will be optimised.<br>- A Consent to Locate (CtL) will be put in place for the drilling rig including a Vessel Traffic Survey (VTS) and Collision Risk Management (CRM) plan.<br>- Kingfisher bulletins will be updated with drilling rig movements and locations, as appropriate.<br>- The drilling rig will have marking and lighting as per CtL conditions -Standard Marking Schedule for Offshore Installations.<br>- The drilling rig will utilise navigational aids, including radar, lighting and AIS (Automatic Identification System).<br>- The drilling rig will be located within the 500 m drill centre exclusion zone. | P | 1 | 4 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| Emissions to air | Exhaust emissions from combustion engines (i.e. burning of diesel) and generation of power on the HDJU resulting in emissions of various combustible gases. | Emissions to atmosphere result in a minor contribution to climate change, acidification and photochemical smog (compared with overall activity in the North Sea).<br>Magnitude of the environmental impact considered to be minor when compared to total UKCS emissions from drill ships, semi-submersibles and HDJU drilling rigs (see Section 6.1) | - The drilling rig will be audited under POUK's HSE Management System / assurance standards.<br>- The drilling rig will be MARPOL compliant with International Air Pollution Prevention (IAPP) requirements.<br>- The drilling rig will adhere to good operating practices and maintenance programmes. | P | 2 | 4 | M |
| Emissions to air | Emissions generated during well clean-up and well testing | Emissions to atmosphere result in a minor contribution to climate change, acidification and photochemical smog (compared with overall activity in the North Sea). | - No extended well testing shall be undertaken.<br>- UK and EU Air Quality Standards not exceeded. | P | 2 | 2 | L |
| Discharges to sea | Planned discharge to sea of WBM and WBM contaminated cuttings. | Short term impact on local water quality. Smothering of benthic organisms, suspended solids, | - All WBM/chemicals used offshore will be subject to the Offshore Chemicals Regulations and risk assessed as part of the application for use/ discharge.<br>- Low toxicity and/or PLONOR chemicals will be used where possible and deemed technically feasible.<br>- Excess WBM/chemicals will be returned to shore and not discharged to sea.<br>- COSHH, Task Hazard Assessments and MSDS sheets will be available on the drilling rig.<br>- POUK will undertake environmental audits of the drilling rig, as appropriate. | P | 3 | 3 | M |
| Discharges to sea | Planned discharge to sea of brine, cement and completion chemicals required in the drilling and well completion process. | Short term impact on local water quality. Impact on species occurring in the water column. | - All brines, cements and chemicals used offshore will be subject to the Offshore Chemicals Regulations and risk assessed as part of the application for use/ discharge.<br>- Low toxicity and/or PLONOR chemicals will be used where possible and deemed technically feasible. | P | 3 | 3 | M |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| | | | - Excess brine/cement and chemicals will be returned to shore and not discharged to sea.<br>- COSHH, Task Hazard Assessments and MSDS sheets will be available on the drilling rig.<br>- POUK will undertake environmental audits of the drilling rig as appropriate. | | | | |
| Discharges to sea | Planned discharge to sea of produced fluids during well bore clean up and well testing | Short term impact on local water quality. Impact on species occurring in the water column. | - All chemicals used offshore will be subject to the Offshore Chemicals Regulations and risk assessed as part of the application for use/ discharge.<br>- Low toxicity and/or PLONOR chemicals will be used where possible and deemed technically feasible.<br>- Well testing discharges will be subject to Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations.<br>- COSHH, Task Hazard Assessments and MSDS sheets will be available on the drilling rig.<br>- POUK will undertake environmental audits of the drilling rig, as appropriate. | P | 2 | 2 | L |
| Discharges to sea | Discharge of domestic sewage and food waste from the drilling rig. | Local water quality deterioration, enrichment. High BOD may have local impact on water quality (deoxygenation), resultant impacts on marine flora and fauna. However, may have positive effect in that nutrients are provided for flora and fauna. | - The drilling rig will comply with relevant MARPOL requirements for discharge of food and sewage wastes. | P | 1 | 4 | L |
| Discharges to sea | Machinery space drainage. Discharge of hydrocarbons / chemicals to sea. | Local water quality deterioration, impact on marine flora and fauna. | - MARPOL compliant filtration and monitoring equipment with discharges of oil in water < 15 mg/l.<br>- POUK will undertake environmental audits of the drilling rig, as appropriate. | P | 1 | 4 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| Seabed disturbance | Impacts of spud cans/anchors/anchor chains on the seabed during positioning of rig | Seabed disturbance in a small area resulting in potential impact to benthic flora and fauna. Environmental surveys in the area identified no Annex I or II habitats or species. | - Pre anchor lay surveys.<br>- Optimised drilling rig moves. | P | 2 | 4 | M |
| Noise and visual impact | Noise and vibration during drilling operations. | Generates elevated sound levels which can affect the behaviour of fish and marine mammals in the area. | - POUK will undertake environmental audits of the drilling rig, as appropriate, including review of drilling rig maintenance programmes to minimise potential for noise generated from poorly maintained rig equipment. | P | 2 | 4 | M |
| Waste | Hazardous and non-hazardous waste. Drilling rigs generate a number of wastes during routine operations including waste oil, chemical and oil contaminated water, scrap metal, etc. | Effects associated with onshore disposal are dependent on the nature of the site or process - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. | - All wastes will be managed and segregated for recycling / disposal / treatment.<br>- Waste will be managed in accordance with regulatory requirements and in line with POUK's waste hierarchy.<br>- Monthly reporting of waste data, including volumes will be sent onshore for performance and compliance monitoring.<br>- The drilling rig will maintain a Waste Management Plan and Waste Record Book. | P | 3 | 4 | M |
| Waste | Skip and ship of OBM mud and OBM contaminated cuttings. | Additional emissions from transport. Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites. | - Cuttings from all OBM sections will be skipped and shipped onshore for treatment and disposal.<br>- Environmental best practice will be used wherever possible. Cuttings will be treated by indirect thermal desorption, the recovered oil will be processed for reuse and the oil free cuttings will be disposed of as non-special waste to landfill. | P | 3 | 4 | M |
| Use of resources | Diesel usage for power generation. | Resource use – energy use. | - The drilling rigs power generation equipment will be subject to maintenance programs and applicable compliance requirements. | P | 1 | 4 | L |
| Use of resources | Utilities. Freshwater - potable supply. | Resource use. | - No significant impacts or mitigations determined. | P | 1 | 4 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| Unplanned discharge to sea | Flare drop out – during well bore clean up and well testing there is potential for flare drop out (unburned hydrocarbons) to fall to sea surface and form a sheen. | Local water quality deterioration, impact on marine flora and fauna. | - Use of high efficiency burners and regular sheen monitoring during relevant operations. | U | 1 | 5 | M |
| Unplanned discharge to sea | Loss of containment of OBM (potentially through a burst hose) resulting in a release to sea. | Local water quality deterioration, impact on marine flora and fauna, localised smothering of seabed and associated biota. | - Bulk transfers and hoses will be managed in accordance with the drilling rigs maintenance strategy and procedures.<br>- The drilling rig will have an approved OPEP in place.<br>- Rig assurance and recertification audits will be undertaken, including review of applicable maintenance and safety requirements on the rig.<br>- An ERRV will be located in field.<br>- POUK is a member of Oil Spill Response Limited and OPOL in the event of Tier 2/3 incident.<br>- Procedures will be in place for bulk transfers and maintenance strategies for hoses.<br>- Standard operating procedures will be adhered to e.g. bunkering in good light, regular hose inspection, correct storage and segregation of chemicals etc. | U | 1 | 5 | M |
| Unplanned discharge to sea | Release of hydrocarbons / chemicals to sea (e.g. from drains, bunkering operations etc.). | Impacts depend on release size, prevailing wind, sea state, temperature and sensitivity of environmental features affected. Birds are most sensitive offshore receptor. Also affected are plankton, fish / fisheries, seabed animals and marine mammals. | - The drilling rig will have an approved OPEP in place.<br>- Rig assurance and recertification audits will be undertaken, including review of applicable maintenance and safety requirements on the rig.<br>- An ERRV will be located in field.<br>- POUK is a member of Oil Spill Response Limited and OPOL in the event of Tier 2/3 incident.<br>- Procedures will be in place for bulk transfers and maintenance strategies for hoses. | U | 1 | 5 | M |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| | | | - Standard operating procedures will be adhered to e.g. bunkering in good light, regular hose inspection, correct storage and segregation of chemicals etc. | | | | |
| Unplanned discharge to sea | Major release to sea of drilling rig fuel hydrocarbon inventory resulting from a vessel collision. | Local water quality deterioration, impact on marine flora and fauna. | - A 500m exclusion zone will be in place at the drill rig / drill centre location.<br>- An ERRV will be located in field.<br>- The drilling rig will have marking and lighting as per CtL conditions - Standard Marking Schedule for Offshore Installations.<br>- Kingfisher bulletins will be updated with drilling rig movements and location, as appropriate. | U | 2 | 3 | M |
| Unplanned discharge to sea | Influx of hydrocarbons into wellbore (loss of hydrostatic overbalance). Controlled hydrocarbon flow to surface / controlled venting of hydrocarbon e.g. via diverters. | Local water quality deterioration, impact on marine flora and fauna. | - Wells will be designed and drilled as per POUK safety standards and practices e.g. well design notification/ examination schemes.<br>- Regular BOP testing will be undertaken as appropriate.<br>- Training and competency of drill crews, including regular well control drills and well control self verification processes will be undertaken. | U | 2 | 2 | L |
| Unplanned discharge to sea | Well blowout (uncontrolled hydrocarbon release in the event of loss of well control). | Damage to commercial fisheries, sediment and water quality impairment and release of atmospheric emissions. Impacts on marine flora and fauna. | - Wells will be designed and drilled as per POUK safety standards and practices e.g. well design notification/ examination schemes.<br>- Use of blowout preventer with testing and maintenance programs undertaken as appropriate.<br>- Relief well planning and well capping device will be available.<br>- Training and competency of drill crews, including regular well control drills and well control self verification processes.<br>- The drilling rig will be subject to rig assurance and recertification requirements.<br>- An approved OPEP will be in place. | U | 4 | 2 | H |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| | | | - POUK is a member of Oil Spill Response Limited and OPOL in the event of a Tier 2/3 event.<br>- ERRV vessel with dispersant and spray equipment will be located in field for support / spill response, as required. | | | | |
| Unplanned seabed disturbance | Dropped objects from drilling rig resulting in physical damage to subsea environment. | Loss of seabed habitat, smothering of benthic organisms. | - Lifting risk assessments will be conducted prior to equipment transfer, including potential risk of dropped objects and/or potential impact to existing infrastructure. | U | 2 | 3 | M |
| **SUBSEA INSTALLATION** | | | | | | | |
| Physical presence of subsea infrastructure | Physical presence of all subsea infrastructure (includes well, flowlines, EHC umbilical, tie-in spools, rock dump, mattresses, grout bags etc.). | Navigation hazard, restriction of fishing operations, snagging risk to fishing nets. | - Infrastructure will be subject to Pipelines Works Authorisations (PWA) and Deposit Consent (DepCon) requirements.<br>- Subsea infrastructure and flowline routes will be added to admiralty charts, Kingfisher database, etc.<br>- Infrastructure will be designed as fishing friendly (not over-trawlable).<br>- 500 m exclusion zone will exist at the drill centre.<br>- Use of rock cover and mattresses will be optimised. | P | 2 | 5 | M |
| Discharges to sea | Discharge of chemicals (e.g. MEG) during leak testing. | Local water quality deterioration, impacts on marine flora and fauna. | - All chemicals used offshore will be subject to the Offshore Chemical Regulations and will be risk assessed as part of the application for use/discharge. Low toxicity and/or PLONOR chemicals will be used where possible and deemed technically feasible.<br>- Excess chemicals will be returned to shore and not discharged to sea. | P | 2 | 3 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| Discharges to sea | Release of hydraulic fluid during subsea valve operation and maintenance. | Local water quality deterioration, impacts on marine flora and fauna. | - Hydraulic fluid selection for the Laverda Field Development will be aligned with the existing Catcher Development Area subsea infrastructure processes and chemical permits.<br>- Use of water-based hydraulic fluid (HW443R). | P | 1 | 3 | L |
| Seabed disturbance | Disturbance associated with installation of subsea infrastructure. | Seabed disturbance, loss of habitat, temporary suspended solids, loss of benthic organisms. Environmental surveys in the area identified no Annex I or II habitats or species. | - Environmental baseline is well understood. Use of rock cover and mattresses will be optimised.<br>- Pipeline installation methodology will be assessed for environmental and social impacts as part of analysis for alternatives. | P | 3 | 4 | M |
| Waste | General waste from pipelay and installation of infrastructure. | Pipelay and installation generate a number of wastes during routine operations including scrap metal, wooden crates etc. Impacts associated with onshore disposal are dependent on the nature of the site or process. Landfills – land take. Treatment plants- atmospheric emissions etc. | - All wastes will be managed and segregated for recycling / disposal / treatment.<br>- Waste will be managed in accordance with POUK waste hierarchy and regulatory requirements. | P | 1 | 4 | L |
| Use of Resources | Consumption of finite materials (e.g. steel) during construction of pipelines and other subsea infrastructure. | Use of non-renewable resources. | - Scrap metal wastes will be managed and segregated for recycling and disposal onshore. | P | 1 | 4 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| **TOPSIDE MODIFICATIONS** | | | | | | | |
| The Laverda Field Development will not require any changes to be made to the topsides of the Catcher FPSO. | | | | | | | |
| **PRODUCTION** | | | | | | | |
| Physical Presence | Vessel requirements. | Relative to existing requirements there will be no increase in vessel requirements at the Catcher FPSO during production as a result of the proposed Laverda Field Development. | | | | | |
| Emissions to Air | Emissions to air as a result of flaring and power generation. | Relative to existing emissions to air from the Catcher FPSO, there is no anticipated increase in total flaring, power generation or helicopter trips as a result of the proposed Laverda Field Development. And a similar reservoir fluid type is anticipated i.e. not sour $H_2S$. | | | | | |
| Noise and Visual Impact | Change to noise and visual impacts. | Relative to existing impacts from the Catcher FPSO, there is no anticipated increase in noise and visual impact during production as a result of the proposed Laverda Field Development. | | | | | |
| Waste | Change to waste generation. | Relative to existing waste production at the Catcher FPSO, there is no anticipated increase in wastes generated as a result of the proposed Laverda Field Development. | | | | | |
| Discharges to sea | Produced water discharge (includes associated hydrocarbons, production chemicals and naturally occurring heavy metals). | Local water quality deterioration, possibly impacting on marine flora and fauna. | - Existing capacity of the Catcher FPSO produced water system is anticipated to be sufficient to manage fluids produced from the Laverda Field.<br>- Reference case for produced water management on the Catcher FPSO is PWRI.<br>- Any PW subject to overboard discharge will be treated to maintain an oil in water content below 30 mg/l and will be subject to Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations (including associated BAT/BEP assessment). | P | 1 | 5 | L |

| Aspect | Activity Description | Impact / Potential Impact | Mitigation / Prevention / Control | Planned/ Unplanned | Magnitude | Duration/ Likelihood | Significance of Impact/ Risk |
|---|---|---|---|---|---|---|---|
| Unplanned Event | Laverda flowline rupture and subsequent release of hydrocarbons to sea e.g. corrosion, snagging by fishing vessels etc. | Local water quality deterioration, impacts on marine flora and fauna. | - Design of lines and materials selection will be fit for purpose.<br>- Pipeline integrity management system, inspection and maintenance routine will be put in place.<br>- Structural and cathodic corrosion protection will be implemented.<br>- Standard operating procedures and checks will be undertaken.<br>- Use of Emergency Shutdown System.<br>- Design Hazard Management Plan.<br>- Exclusion zone will be put in place at the drill centre.<br>- Pipeline routes will be added to admiralty charts, FishSafe, etc.<br>- Flowlines and umbilicals will be protected by rock cover and mattresses as appropriate. | U | 2 | 2 | M |
| Unplanned Event | Laverda subsea control system failure resulting in a minor release to sea of hydraulic/control fluid. | Local water quality deterioration, impacts on marine flora and fauna. | - Integrity management systems, inspection and maintenance will be put in place.<br>- Design of lines and materials selection will be fit for purpose.<br>- Standard operating procedures and checks will be undertaken.<br>- All hydraulic fluid used offshore will be subject to the Offshore Chemicals Regulations, and will be risk assessed as part of the application for use/ discharge.<br>- Use of water-based hydraulic fluid HW443R in accordance with rest of Catcher Field.<br>- Use of Engineered Installation Procedures. | U | 1 | 3 | L |