BP EXPLORATION OPERATING COMPANY LIMITED

Vorlich Environmental Statement

ES identification no. D/4209/2018 | March 2018

Intertek Energy & Water Consultancy Services
Exploration Drive, Bridge of Don, Aberdeen AB23 8HZ, United Kingdom

ES SUBMISSION INFORMATION

Environmental Statement Details

Section A: Administrative information

A1 – Project Reference Number

ES identification number: D/4209/2018.

A2 - Applicant Contact Details

Company name: BP Exploration Operating Company

Contact name: Clare Sloan

Contact title: Miss

A3 - ES Contact Details (if different from above)

Company name: As above

Contact name: As above

Contact title: As above

A4 - ES Preparation

Name	Company	Title	Relevant Qualifications/ Experience
Anna Farley	Intertek	Associate Director	13 years marine consultancy experience, specialising in marine environmental impact assessment, oil and gas permit and consents.
Patricia Adams	Intertek	Senior Consultant	9 years' experience working in oil and gas and environment impact assessment.
Kerri Gardiner	Intertek	Consultant	8 years' experience in environmental impact assessments.
Katrina Hall	Intertek	Senior Scientist	6 years' experience in environmental impact assessment
Richard Marlow	Intertek	GIS Specialist	12 years' experience in GIS systems, data management and programming
Jenny Arthur	Intertek	GIS Specialist	2 years in GIS systems and data management
Clare Sloane	BP Exploration Operating Company Ltd	Environmental Specialist	7 years' experience working in environmental management and impact assessment in oil and gas.

A5 - Licence Details

a) Licence(s) : 1588 (30/1f) and P363 (30/1c)

b) Licensees and current equity outlined in table(s) below:

Licence number	P1588
Licensee	**Percentage Equity**
Ithaca	100%

Licence number	P363
Licensee	**Percentage Equity**
BP Exploration Operating Company	80%
Ithaca	20%

Section B: Project Information

B1 - Nature of Project

a) Name of Project: Vorlich Development

b) Please specify the name of the ES (if different from the project name): Vorlich Environmental Statement

c) Brief description of the project: Development of the field will comprise of:

- Two production wells tied-back to the Stella FPF-1 floating production unit (hereon referred to as FPF-1); and
- An export production pipeline installed between the Vorlich drill centre and FPF-1.

It is currently planned to drill the first well in Quarter 2 of 2019 followed by manifold, pipeline and umbilical installation in Q2 2020. First oil is expected July 2020 with field life anticipated to be 10-years.

A2 - Applicant Contact Details

Company name: BP Exploration Operating Company

Contact name: Clare Sloan

Contact title: Miss

B2 - Project Location

a) Offshore location(s) of the main project elements.

Quadrant number(s): 30

Block number(s): 1c

Latitude: 56° 52' 03.92" N Longitude (W / E): 002° 04' 18.65" E

Distance to nearest UK coastline (km): 241km

Which coast? Scotland

Distance to nearest international median line (km): 23km

Which line? UK/Norway median line

B3 - Previous Applications <if applicable>

Name of project: N/A

Date of submission of ES: N/A

Identification number of ES: N/A

DOCUMENT RELEASE FORM

BP Exploration Operating Company Limited

ES identification no. D/4209/2018

Vorlich Environmental Statement

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Authoriser

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Rev No	Date	Reason	Author	Checker	Authoriser
Rev 0	09/03/2018	Original	PAD	PAD	ALF

Intertek Energy & Water Consultancy Services is the trading name of Metoc Ltd, a member of the Intertek group of companies.

NON-TECHNICAL SUMMARY

This non-technical summary (NTS) of the Vorlich environmental statement (ES) provides a summary of the following aspects of the proposed development:

- Introduction to the project and selected concept;
- Project approach;
- The baseline environment;
- Environmental hazards, effects and mitigation measures;
- Unplanned events;
- In-combination, cumulative and transboundary effects; and
- Conclusions

Introduction to the project

The proposed Vorlich development comprises of two production wells that will be tied back to the Stella FPF-1 floating production unit (FPF-1) via an export production line. The development is located in the Central North Sea in Block 30/1c UPPER (Vorlich field) and Block 30/6a (FPF-1).

The field is being developed by BP Exploration Operating Company Limited (BP) and Ithaca Energy (UK) Limited (Ithaca). It has been agreed that BP will be the field operator and will procure and install equipment related to the wells; Ithaca will procure, install and commission the pipeline and associated topside modifications at FPF-1.

Under the following legislation, to obtain consent to progress the development, an ES is required. This reports the results of an Environmental Impact Assessment (EIA) evaluating the Vorlich development.

- The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017 (S.I. 2017/582) (the “EIA Regulations”);
- The Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2017; and
- The Conservation of Offshore Marine Habitats and Species Regulations 2017.

The proposed concept

BP’s North Sea strategy is to reduce risk, sustainably drive efficiencies, improve recovery from large reservoirs and to invest efficiently in new options. This is aligned with the Oil and Gas Authority (OGA) Maximising Economic Recovery (MER) UK Strategy. The proximity of Vorlich to key infrastructure will enable rapid development of the resource and aligns with the regional strategy.

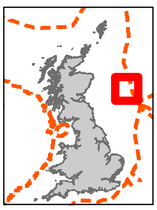
The Vorlich development was subject to a concept assessment. The criteria used during the selection process included consideration of safety and operating risk, environmental and social management, operability, and project execution, subsurface and financial factors. Surface (i.e. new normally unmanned installation) and subsea (i.e. manifold tied-back to existing host facility) options were considered; and the subsea concept was selected on environmental, safety and financial grounds.

Following the decision in favour of the subsea concept, host selection was carried out. Two options were evaluated; the Shearwater platform and the FPF-1. The FPF-1 was selected as the third-party host as it provides the opportunity for production acceleration (project schedule supports first oil in third quarter of 2020); enables export of increased natural gas liquids with new Natural Gas Liquid (NGL) processing capacity; and requires a shorter tie-back pipeline and therefore has a reduced environmental impact (in comparison to Shearwater).

The concept selection process concluded that the preferred concept is two wells (produced through natural depletion), tied back via a subsea manifold to existing producing facility FPF-1, which exports oil and gas to market via the existing Norsea terminal and Central Area Transmission System pipeline respectively.

Legend

- Producer 1
- Producer 2
- Vorlich Drill Centre
- FPF-1
- Vorlich Pipeline
- Well
- Platform
- FPSO
- Cable
- Pipeline
- Median Line
- Licence Block
- Hydrocarbon Field
- Potential Submarine Structure within Pockmark
- NCMPA
- MCZ



NOTE: Not to be used for Navigation

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Figure 1-1: Location Overview

Date	Wednesday, March 7, 2018 09:51:10
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	CDA, OSOD, JNCC, ESRI, TCE
File Reference	J:\P2206\Mxd\ Location_Overview_v2.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Kerri Gardiner

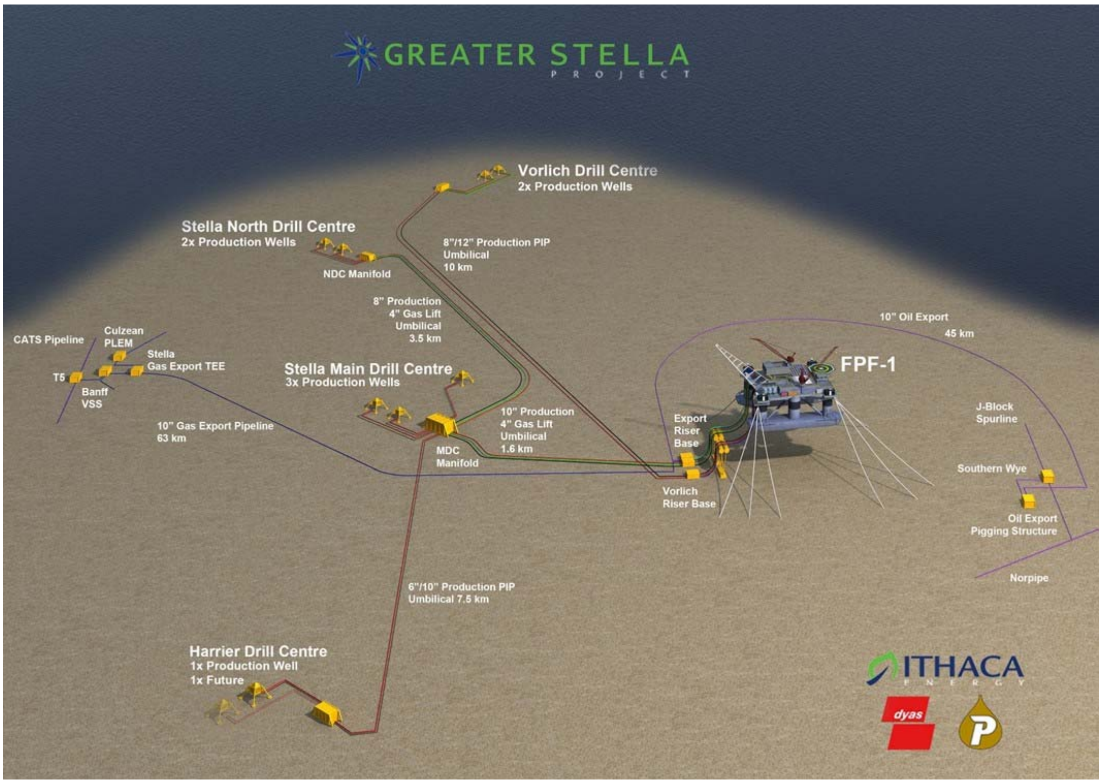
0 6 12 18 24 30 km

Project description

Operations are scheduled to commence in second quarter of 2019 with first oil for Vorlich anticipated for July 2020. The development is summarised as follows and illustrated in Figure 1-2:

- A drilling template, a steel frame with slots for each well and supporting legs that is lowered onto the seafloor, will be installed.
- Two producer wells will be drilled through the drilling template from a semi-submersible drilling rig.
- Well testing, flaring (burning off) crude oil and gas from the wells, to test productivity of the wells may be required.
- Xmas trees will be installed at each well and a subsea manifold will be installed adjacent to the wells. The manifold will be piled, to anchor it in place. The wells will be connected to the manifold.
- An 8"/12" pipe-in-pipe production pipeline will be installed and commissioned between the manifold and the FPF-1.
- Pipeline protection materials will be deposited at the site of pipeline crossings.
- Modifications will be carried out on the FPF-1 topsides to facilitate the Vorlich development including NGL processing modifications and new chemical skid.

Greater Stella Field after installation of Vorlich subsea tie-back



Oil reserves at Vorlich are estimated to be 34 million barrels of oil equivalent (reference case). The hydrocarbons are volatile oil i.e. gas with high levels of natural gas liquids (condensate). The production wells are expected to produce a peak rate of 1566 tonnes oil and 1.9 million m3 gas (reference case) and 1827 tonnes oil and 1.9 million m3 gas (upside-case) in the first full year, gradually reducing throughout field life. End of field life (cessation of production) upside-case is expected to be in 2030.

Baseline and environmental description

For the EIA, the baseline environment has been divided and considered as:

- Physical: metocean, air quality, water quality and seabed conditions;
- Protected and sensitive sites;
- Biological: benthos, plankton, fish and shellfish, seabirds and marine mammals; and
- Socio-economic: commercial fisheries, shipping and other marine users.

A good understanding of the baseline for these attributes has been achieved through two activities:

- Reviewing marine survey data for the development area and surrounds; and

Collating and reviewing secondary data sources (e.g. existing studies, literature and reports) referenced throughout the text. Seabed surveys

Three seabed surveys have been undertaken within or near the development area. The data acquired provides an overview of the development area in terms of the geological and sediment features, bathymetry, habitats and sensitive/protected features present. BP commissioned a desk-top study to review historic survey data, identify potential environmental sensitivities and identify any gaps that required acquisition of new survey data. This exercise led to a targeted survey being completed in 2017 to inform the EIA. The EIA references the initial survey report which provides information on bathymetry, seabed features and a high-level description of the habitats present. The full environmental baseline report, that includes detailed analysis of the benthic samples taken, will be available in April 2018 (post EIA submission). It has been agreed with the Department of Business, Enterprise & Industrial Strategy (BEIS) that the findings of the environmental baseline survey will be incorporated into permit applications for drilling and pipeline installation activities.

Physical Environment

- The CNS maintains a relatively constant sea bottom temperature throughout the year, ranging between 6°C in winter and 7°C in summer. Sea surface temperatures around the development area vary seasonally between 6°C and 8.5°C in winter and between 14.5°C and 15°C in summer. The CNS area is subject to moderate to strong breezes, which give rise to a generally moderate wave regime with significant wave heights over 2m. Residual current speeds near the development area are 0.16ms-1.
- Levels of primary atmospheric pollutants tend to be highest close to their sources. It is expected that the development area, which is 241km from the nearest coastline, is unlikely to suffer from air quality issues.
- The water depth at Vorlich ranges from approximately 75m in the south-east to over 90m in the north-west. The seabed within the development area comprises of fine sands and silts and is described as relatively featureless, although there are numerous depressions, boulders and debris towards the west of the development area. Analysis of sediment samples form the Greater Stella Area (within which the development lies) typically show contamination concentrations at background levels.

Protected and sensitive sites

- The development area does not lie within a protected or sensitive site.
- The East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA) lies 29km to the west; and the Fulmar Marine Conservation Zone (MCZ) lies 29km to the south. The East of Gannet and Montrose Fields is designated for the protection of ocean quahog (a priority marine feature (PMF)). The designated features of the Fulmar MCZ are subtidal mud, subtidal sand (PMF) and subtidal mixed sediment, and ocean quahog (PMF).
- Sensitive habitats found in the North Sea include ‘submarine structures made by leaking gases’, ‘reef’ and ‘sandbanks which are slightly covered by seawater all of the time’. No potential submarine structures within

pockmarks were observed during the 2017 survey or in any other survey reviewed by the desk-top study. The closest areas of known pockmarks, reef or sandbanks are at least 70km away.

Biological Environment

- **Benthos** – Benthic communities comprise of species (excluding commercially exploitable shellfish) that live on (epifauna) or in (infauna) sediments. The 2017 survey assigned the EUNIS biotope complex 'circalittoral muddy sand' (A5.26), corresponding to the Joint Nature Conservation Committee classification 'circalittoral muddy sand' (SS.SSa.CMuSa), to the seabed within the development area. This soft sediment community is typically defined by infaunal taxa, in particular, a wide variety of polychaetes and bivalves. Epifauna was found to be relatively sparse, although there was some evidence of disturbance of sediments (bioturbation) by deep burrowing animals in the form of pit, mounds and Norway lobster burrows in the region. An image of the epifauna observed during the 2017 survey is shown in the figure below.

Two OSPAR listed habitats/species were observed in the development area: individual ocean quahog, which is also a Priority Marine Feature (PMF); and sea pens and burrowing megafauna communities.

Epifauna and sediments observed in the development area

Soft sediments characterised by the sea pens *Virgularia mirabilis* and *Pennatula phosphorea.*

The epifaunal community associated with the soft sediments included: Norway lobster (*N.norvegicus*), swimming crab (*Liocarcinus depurator*) and hermit crabs (*Pagurus bernhardus*).

Encrusting, tube dwelling polychaetes (Serpulidae) and hydroid/bryozoan meadow were observed on shell material.

- **Plankton** – Plankton comprises aquatic organisms which are incapable of swimming against a current. They include two main groups: phytoplankton and zooplankton. Peak plankton abundance in the CNS occurs towards the end of spring; a secondary peak in abundance occurs in late summer/early autumn. The zooplankton in the CNS exhibits a seasonal and geographical variation in abundance and distribution that is closely linked to the over-wintering predatory species and food availability. Regional Sea 1, where Vorlich is located, is characterised by deep, cool and stratified waters, supporting a rich diversity of zooplankton species.

- **Fish and shellfish** – Five species (Atlantic cod, Atlantic mackerel, Norway pout, European plaice, sandeel), two of which are PMF, have been identified as likely to use the development area and surrounds for spawning and nursery grounds; lemon sole is also likely to spawn in the area; and eight species (anglerfish, Atlantic herring, blue whiting, common ling, European hake, haddock, spotted ray, spurdog), three of which are PMF, use the area as nursey grounds only. Species identified as PMF, defined by Scottish Natural Heritage, are of conservation importance.

- **Seabirds** – Seabirds commonly sighted within the CNS include northern gannet, European storm petrel, common guillemot, northern fulmar, great skua, black-legged kittiwake, great black-backed gull and European herring gull. Based on the Seabird Oil Sensitivity Index (SOSI), sensitivity to oil pollution in the development area and at FPF-1 (Blocks 30/1 and 30/6) is considered low for the duration of the year.

- **Marine mammals and reptiles** – Cetacean abundance in the CNS is relatively low compared to other north-western European waters and both the number of species and the frequency of sightings (taken here as a measure of abundance) tends to decrease southwards through the North Sea. Sightings data suggests that harbour porpoise and Atlantic white-beaked dolphin are resident to the CNS and may be present in low to moderate densities; minke whale and Atlantic white-sided dolphin may be present in low densities in the spring and summer, respectively.

Two species of pinniped occur in the CNS: common and grey seals. The Marine Planning Portal indicates that common seal and grey seal densities in the development area are low (<1 seal per 5km2), given its distance offshore.

Marine turtles are the only marine reptiles found in UK waters. Only the leatherback turtle is a regular visitor, with occasional sightings in the North Sea. In Regional Sea 1, where the development area is located, the majority of leatherback turtle sightings between 2000 and 2011 were coastal and therefore not expected at the development area.

All cetaceans are European Protected Species (EPS) protected under Annex IV of EC Directive 1992/43/EEC (Habitats Directive), which lists species of Community Interest in need of strict protection. It is an offence to deliberately capture, kill, injure or disturb animals classed as EPS. Harbour porpoise, bottlenose dolphin, grey seal and common seal are listed under Annex II of the Habitats Directive, which lists species whose conservation requires designation of Special Areas of Conservation (SAC). The closest SAC's designated for the protection of these species are over 150km from the development area.

Socio-economic environment

- **Commercial fisheries** – While the CNS is important fishing grounds, annual fishing effort in the International Council for the Exploration of the Sea (ICES) rectangle 42F2 where the development is located, is typically lower than neighbouring rectangles both in terms of value and tonnage landed. European plaice and lemon sole were reported as the highest value and greatest tonnage landed from 42F2 in 2016 (The Scottish Government 2017).
- **Shipping and navigation** – The development is in relatively open waters, although heavily developed by oil and gas. There are 30 shipping routes passing within 18.5km (10nm) of the development area; 6 of which pass within 3.7km (2nm). The nearest surface structures to the development are the Jade platform 11.3km (6.1nm) to the east; the Franklin platform 16.6km (9nm) to the northwest; and Jasmin platform 17.9km (9.7nm) to the southeast.
- **Other marine users** – The area is heavily developed by oil and gas activity (520 wells, 17 platforms, 121 pipelines within 40km of the development). However, except for a telecommunications cable (TAMPNET) 25km distant from the development, the area is not of importance to other marine users.

Environmental hazards, effects and mitigation measures

Impact assessment

The impact assessment has been carried out in three stages as follows:

1. Definition of the existing baseline environment surrounding the project location, in terms of the physical, biological and human environments – see Section 4.
2. Identification of the activities that have the potential to impact the baseline environment and their subsequent assessment. The assessment has been based on the potential severity and likelihood of an impact. The assessments assume that activities will be carried out in accordance with all current legislation and industry best practice.
3. The potential for transboundary and cumulative impacts have been assessed, both within the proposed operation, or when combined with other external activities.

Potential environmental impacts have been categorised using severity classes adapted from the environmental risk assessment guidance produced by UKOOA (1999). These potential impacts have then been assessed using a risk matrix, based upon International Standard BS EN ISO 17776:2002. This has been adapted for use by Intertek to provide the criteria for oil and gas operations. Risk is a term in general usage to express the combination of the likelihood of a specific impact occurring and the severity of the consequences that might be expected to follow from it.

Impacts identified and assessed in the EIA are summarised below:

Physical presence

The presence of a 500m safety exclusion zone around the Vorlich drilling centre will result in vessels (shipping & fishing) temporarily being displaced from the area. A vessel traffic study undertaken for the development concluded that there was sufficient sea room available for vessels to adjust passages without causing disruption. The relatively short duration (204 days) of the exclusion zone and the low level of fishing activity in the area has also contributed to the risk being assessed as **acceptable** for shipping, commercial fisheries and other marine users.

Generation of atmospheric emissions

Gas emissions will result from drilling operations, pipeline installation and production (flaring) activities at Vorlich.

Global warming potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere; usually expressed as CO_2 equivalent (CO_2-e). Calculations undertaken for the EIA indicate that during field development (drilling, pipeline installation and one flaring event) approximately 51074 tonnes CO_2-e will be released. This decreases to 33242 tonnes per annum CO_2-e once the field is producing. This scale of emissions represents a very small portion of UK greenhouse gas emissions. In addition, there may be an incremental increase in flaring on the FPF-1 following the Vorlich tie-in. This will be reviewed within the asset flare permits in future once steady performance data is available.

The risk posed to air quality from the generation of atmospheric emissions has been assessed as **acceptable**.

Generation of underwater noise

Underwater noise generated by the development falls into two categories; impulsive noise (e.g. piling); and continuous noise (e.g. pipeline trenching, rock or mattress placement, vessels using dynamic positioning and drilling. The criteria set-out by Southall et al. (2007) has been used for impact assessment. This separates marine mammals into five groups based on their functional hearing, namely: low-frequency cetaceans (minke whale); mid frequency cetaceans (Atlantic white-beaked dolphin and Atlantic white-sided dolphin); high frequency cetaceans (harbour porpoise); pinnipeds in water; and pinnipeds in air (grey and harbour seal) and proposes thresholds at which injury and disturbance may result.

The EIA uses conservative sound attenuation calculations to determine how far underwater noise from activities is likely to travel before it falls below the thresholds for injury and disturbance. The calculations demonstrate that the thresholds for injury are not exceed by an activity.

Both impulsive noise and continuous noise sources have the potential to disturb marine mammals, particularly high-frequency cetaceans such as harbour porpoise. The calculations suggest sound pressure levels that exceed the threshold for disturbance for harbour porpoise could occur within 120km of the development area (result for piling). Calculations for continuous noise sources indicate there is potential to cause disturbance to low, mid and high frequency cetaceans within 7.5km of the development area. This is a conservative estimate as it does not account for the increased attenuation of high frequency sound in water (Spiga 2015); seabed interactions; seabed type; change in salinity, bathymetry, temperature or density; and level of existing background noise, which would reduce the zone of ensonification.

The piling of the manifold is planned for April 2020; duration of the activity will be extremely short (one hour per pile, total four hours). Minke whale is the only cetacean likely to be present (in low densities) during April. Research indicated (JNCC 2016) that harbour porpoise are unlikely to be present in the development area, preferring more southerly sectors of the North Sea (off East Anglia and Thames Estuary) during winter months).

The assessment concluded that the risk posed to plankton, fish, marine mammals and protected sites from underwater noise is **acceptable.**

Marine discharges

The safe drilling and completion of a well requires a large volume of chemicals. Chemical discharges will occur throughout the drilling campaigns and pipeline installation. All proposed discharges must be risk assessed as part of the chemical permitting process ahead of activities commencing, and will be subject to the conditions set in the approved permit. Water column species are only likely to be vulnerable within a short distance of any discharge, as chemicals will be rapidly diluted to below potentially toxic concentrations under the energetic conditions prevalent in the UKCS. Therefore, no significant impact is anticipated at population level. There will be no additional produced water discharges from the FPF-1 because of the development.

The assessment concluded that the risk posed to water quality, sediments, plankton, benthos, fish and shellfish, marine mammals and protected sites from marine discharges is **acceptable**.

Seabed footprint

Activities that will disturb the seabed and result in a seabed footprint have been identified as anchoring associated with the semi-submersible drilling rig; drill cuttings deposition; pipeline installation; and deposit of pipeline protection materials.

Anchoring and pipeline trenching will cause temporary disturbance to seabed sediments and benthic fauna. It has been calculated that approximately 0.22km2 of seabed will be affected by the development; in the form of small patches associated with anchor placement, and a narrow but long strip of seabed where the pipeline is installed. The benthic community within the development area is typical of the CNS, and disturbed areas are likely to be re-populated by undistributed individuals from the surrounding area. Disturbance is not expected to impact the wider habitat or species populations.

Deposit of pipeline protection and the manifold will result in permanent loss of habitat as the soft sediment (mud) is replaced with hard infrastructure. Given that the footprint of these activities is very small (maximum of 0.01km^2 including contingency) it is not expected to significantly impact benthic communities and the wider habitat.

The deposition of drill cuttings can also be considered a permanent loss of habitat as the cuttings pile will take years to erode. Results from studies show that impacts to benthic communities are generally confined to the immediate vicinity of the well and communities can recover (OGUK 2014) from disturbance.

The assessment concluded that the risk posed to sediments, benthos, fish and shellfish, protected sites, commercial fisheries and other marine users from the seabed footprint of the development is **acceptable**.

Susceptibility to natural disasters

The probability of a major natural disaster occurring in UK waters which could impact the development area is extremely low. In the North Sea, the frequency of occurrence of a magnitude 4 natural seismic event is expected to be approximately every two years and that of a magnitude 5 event every 14 years. These events will not cause a natural disaster or likely to result in significant damage to offshore infrastructure.

Mitigation measures

Mitigation measures identified are listed below:

- **M1**: Project vessels will follow the International Maritime Organisation (IMO) Regulations to reduce the likelihood of collision i.e. shall comply with Standard Marking Schedule. This includes requirements for navigation, lighting, obstruction lighting and beacons.
- **M2**: Users of the sea will be notified of the presence and intended movements of the project vessels via the Kingfisher Fortnightly Bulletins, Notices to Mariners, Notice to Lighthouse Board, and very high frequency (VHF) radio broadcasts.
- **M3**: BP and Vorlich partners will undertake practical steps, such as ensuring efficient operations, keeping power generation equipment well maintained and monitoring fuel consumption, to minimise atmospheric emissions.

- **M4**: All vessels employed during drilling activities will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, which controls the levels of pollutants entering the atmosphere.
- **M5**: Inspection and maintenance programmes will be used in line with the requirements of indicative best available technique (BAT) to ensure that power generation equipment is kept and operated in a manner to optimise efficiency and minimise fuel consumption.
- **M6**: BP and Vorlich partners will be required to review BAT assessments as part of the application for permission to vent and flare associated with the drilling/ FPF-1 installation. These assessments and the subsequent permits will ensure that greenhouse gas emissions are kept to the minimum consistent with operational requirements for maintaining the development.
- **M7**: A dedicated Marine Mammal Observer (MMO) will conduct visual surveys during piling activities within hours of daylight.
- **M8**: The JNCC protocol for minimising the risk of injury to marine mammals from piling noise will be followed.
- **M9**: Chemical use and discharge will be regularly reviewed and kept to the minimum consistent with operational requirements.
- **M10**: Where suitable alternatives are available and deemed fit for purpose, chemicals with lower potential for environmental impact will be reviewed.
- **M11**: Chemical storage and usage is in accordance with the vessel’s Control of Substances Hazardous to Health (COSHH) procedure and Material Safety Data Sheets are carried for all hazardous substances.
- **M12**: Rock placement will only be employed where the integrity of the pipeline is at risk. Cover will be kept at the minimum required to ensure pipeline protection is adequate. Industry best practice shall be used when deploying rock dump.
- **M13**: The manifold is designed to be a slab-sided fishing friendly structure with no snaggable protrusions.

Residual impacts

The EIA concluded that there will be no residual impacts from the development activities.

Unplanned events

It is possible that during the lifecycle of the Vorlich development an event may occur which results in unplanned releases to the environment. Possible types of unplanned releases include hydrocarbons; diesel (fuel); and chemicals e.g. drilling muds, drilling chemicals, pipeline chemicals etc.

Any unplanned release has the potential to impact the environment. However, the significance of the impact depends upon numerous factors including (but not limited to) the substance released, volume of release, toxicity, meteorological conditions at the time, and sensitivity of the receptors.

Five unplanned release scenarios have been identified as possible during the Vorlich development lifecycle; loss of well control (well blow out); loss of primary containment on the drilling rig or pipelay vessel; release of the pipelay inventory (e.g. due to pipeline rupture); drop-out from the flare during well testing; and an unplanned release of chemicals e.g. during drilling. Of the scenarios described the well blow out represents the worst-case volume of unplanned hydrocarbon release in the environment and is therefore assessed in the EIA.

Modelling has been completed by Oil Spill Response Limited (OSRL) using SINTEF’s Oil Spill Contingency and Response (OSCAR) model. OSCAR is a 3D modelling tool used to predict movement and fate of oil on the sea surface and throughout the water column. The modelling results have been used to assess the potential environmental impacts. Additional modelling will be undertaken in the preparation of the Oil Pollution Emergency Plan (OPEP).

Hydrocarbons present in sufficient quantities to result in a Major Environmental Incident (MEI) are restricted to Group 1 oils (i.e. condensate and oil, specific gravity below 0.8). These are considered non-persistent in the marine environment, and modelling indicates that the total hydrocarbon concentration will disperse away from the point of release.

The potential environmental impacts of an unplanned hydrocarbon release have been assessed with reference to the key sensitive receptors – plankton, fish, marine birds, marine mammals and protected sites.

- **Plankton and fish** - Unplanned releases have the potential to cause toxic harm to plankton and fish communities. While there are instances in which there could be risk posed to stocks, this is unlikely at the Vorlich development. Therefore, assessment concluded that the unlikely event of an unplanned hydrocarbon release poses an **acceptable** risk to plankton and fish communities.
- **Marine mammals** - Unplanned releases of hydrocarbons present a risk to cetacean and pinniped species near the release. While marine mammals are present in only low densities around the development area, it has been identified that a sustained unplanned release of hydrocarbons between December and February has a 34% probability of entering the Southern North Sea cSAC after 23 days. A designating feature of this site is harbour porpoise (also an EPS under EC Habitats Directive and protected under Annex II and IV of the Habitats Directive). Given the extent of the cSAC (36,951km2) and the low densities of harbour porpoise in the northern area of the cSAC (in which hydrocarbon has potential to enter) during December to February, it is unlikely that a release will significantly impact the conservation objectives of the Southern North Sea cSAC. Therefore. the assessment concluded that the unlikely event of an unplanned hydrocarbon release poses an **acceptable** risk to marine mammals.
- **Seabirds** - Seabird sensitivity to oiling in the development area as low throughout the year. In neighbouring Blocks, sensitivity to oil is generally low with moderate sensitivity to oiling south east of the development in February, and high sensitivity to oiling north of the development in September and October. The assessment concluded that the risk to marine birds is **tolerable**, which with the implementation of mitigation measures M14 and M15 (see below) is reduced to acceptable.
- **Protected sites** - The ten offshore marine protected sites within 150km of the development are designated primarily to protect physical features (e.g. sandbanks, reefs) or seabed habitats. All sites are continuously submerged. It is unlikely that an unplanned hydrocarbon release would affect the conservation status of any of the sites. In addition, the probability of the spill beaching in coastal areas is only 2% and is therefore unlikely to affect coastal protected sites. Therefore, the assessment concluded that the unlikely event of an unplanned hydrocarbon release poses an **acceptable** risk to protected sites.
- **Aquaculture** - Given that a release only has a 2% probability of beaching on the coast, it is unlikely that it will impact any aquaculture sites.

Mitigation measures that will be implemented to minimise the risks of unplanned releases include:

- **M14:** Prevention - All operational personnel, whether in the direct employ of BP, Ithaca or contractors will be made aware of existing environmental protection procedures and the crucial importance of maintaining the integrity of the containment policy. The risk of a spill is tackled on a day-to-day basis by Vorlich partners employees and contractors following good practice codes, collision avoidance and fuel handling and transfer procedures. Every effort will be made to prevent such releases. It is noted that most releases occur during offshore fuel transfer operations (bunkering) and as such BP are committed to the following measures during drilling operations:

  The connection between the fluid transfer hose and the supply vessel for offshore hydrocarbon and brine transfers shall be a self-sealing, dry-break hose connection.

  Preference shall be given to carrying out external fluid transfers during the hours of daylight. If operational reasons dictate that external fluid transfer are carried out during the hours of darkness then they shall be subject to documented risk assessment which shall include environmental and safety considerations.

  Fluid transfer during hours of darkness shall not commence without provision of sufficient illumination to allow the entire length of the transfer hose to be visually monitored from the installation.

If operational reasons dictate that simultaneous external fluid transfers of more than one hydrocarbon fluid product is required, it shall not take place until a full documented risk assessment has been made.

- **M15**: Control - In line with the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015 and the Offshore Installations (Emergency Pollution Control) Regulations 2002 an approved OPEP will be in place for the project and drilling scope. This will cover response measures to be taken to protect the environment in the event of a spill. As discussed in the preceding section, this OPEP will provide detailed hydrocarbon release and spill scenarios to enable the determination of appropriate offshore actions. In addition, it outlines reporting and training requirements for mitigating accidental spillage throughout all phases.

  BP operates a three-tier response system, based on the following key factors: hydrocarbon type and properties, potential quantities released, metocean and metrological data, environmental and economic sensitivities and the response capabilities of both BP and Oil Spill Response Limited (OSRL).

  - Tier 1 is a local response, geared at the most frequently anticipated oil spill.
  - Tier 2 is a regional response for a less frequently anticipated oil spill where external resources and assistance in monitoring and clean-up will be required.
  - Tier 3 is a national response for very rarely anticipated oil spills of major proportions which will potentially require national and international resources to assist in protecting vulnerable areas and in the clean-up.

  The response strategies available following a release include aerial surveillance, application of dispersant, well capping, and drilling of relief wells. Any spills (diesel, condensate or chemical), including sheens, will be reported to the statutory authorities using the PON1 reporting system. For larger spills, a comprehensive range of back-up resources is available to BP through oil spill providers e.g., OSRL. However, the likelihood of a blow-out occurring is extremely rare.

In-combination, cumulative and transboundary effects

The term 'in-combination impacts' refers to impacts upon receptors from different activities within the same project. This has been considered by way of this EIA.

The term 'cumulative impact' refers to impacts upon receptors arising from the Vorlich development when considered alongside other past, present or reasonably foreseeable projects, plans or licensed activities, that may result in an additive impact with any activities of the development.

There are six oil and gas fields near the development (within a 20km radius). Activities assessed include seabed disturbance leading to habitat loss, generation of underwater noise, increased activity in the region, generation of atmospheric emissions and marine discharges. The closest fields, Stella and Harrier (both 4km distant) are unlikely to interact with the proposed operations based on the anticipated footprint of the development. The assessment concluded that the development will not result in any cumulative impacts.

There are no windfarm developments, aggregate extraction and disposal sites or any other projects or plans (excluding oil and gas activity described above) with the potential to interact with the development.

The development is 23km to the west of the UK/Norway median line. Potential transboundary impacts were considered as follows: air quality, planned marine discharges and unplanned hydrocarbon release.

Air quality and marine discharge impacts are not anticipated to cause a significant transboundary impact.

An unplanned hydrocarbon release however has the potential to enter Norwegian, Danish, German and the Netherlands waters, at the surface and in the water column. The Oil Pollution Emergency Plan will need the measures to be taken with respect to international cooperation following an unplanned oil release entering neighbouring jurisdictional waters.

Conclusions

This ES has established the following:

- Risks posed to the marine environment have been assessed as acceptable or the risk reduced to acceptable after assessment with proposed mitigation measures;
- Two OSPAR listed habitats/species were observed in surveys at the development area: ocean quahog, which is also a Priority Marine Feature (PMF); and sea pens and burrowing megafauna communities;
- There are no protected or sensitive sites located within the development area, and the risk posed to protected sites further afield have been assessed as acceptable. The development will not pose a threat to the integrity of the conservation objectives for these sites;
- The risk posed by the potential for cumulative effects is acceptable; and
- Transboundary impacts will only result from a major unplanned hydrocarbon release.

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GLOSSARY

° C
Degrees Celsius

µPa
Micropascal

30/1c
30/1c UPPER

AIS
Automatic Identification System

ALARP
As Low As Reasonably Practicable

API
American Petroleum Institute

BAT
Best Available Technique

bbl
Barrels

BEIS
Department for Business, Energy and Industrial Strategy

BOP
Blowout Preventer

BP
BP Exploration Operating Company Limited

bpd
Barrels Per Day

BS EN ISO
British Standard European Norm International Standards Organisation

CAPEX
Capital Expenditure

CH_4
Methane

CNS
Central North Sea

CO
Carbon Monoxide

CO_2
Carbon Dioxide

CO_2-e
Carbon Dioxide Equivalent

CoP
Cessation of Production

COSHH
Control of Substances Hazardous to Health

Cr
Chromium

cSAC
Candidate Special Area of Conservation

CTIA
Construction & Tie-in Agreement

dB
Decibels

DP
Dynamically Positioned

DSV
Dive Support Vessel

DWT
Deadweight Tonnage

E
East

EC
European Council

ECMRWF
European Centre for Medium-Range Weather Forecasts

ED
European Datum

EDR
Effective Deterrence Radius

EIA
Environmental Impact Assessment

EPS
European Protected Species

ES
Environmental Statement

ETAP
Eastern Trough Area Project

EU-ETS
European Union - Emissions Trading Scheme

EUNIS
European Nature Information System

FGRU
Flare Gas Recovery Unit

FWD
Forward

GES
Good Environmental Status

GHG
Greenhouse Gases

GOR
Gas/Oil Ration

GPO
Global Projects Organisation

GWP
Global Warming Potential

GSA
Greater Stella Area

H_2S
Hydrogen Sulphide

HP
High Pressure

HS&E
Health, Safety & Environmental

HSSE
Heath, Safety, Security and Environment

ICES
International Council for the Exploration of the Sea

ICSS
Integrated Control and Safety System

IMO
International Maritime Organisation

IOPPS
Instrumented Overpressure Protection Systems

Ithaca
Ithaca-Energy (UK) Limited

kg
Kilogram

kHz
Kilohertz

km
Kilometres

km^2
Kilometres squared

LP
Low Pressure

m
Metre

m^2
Metres Squared

m^3
Cubic Metres

MarLin
The Marine Life Network

MCZ
Marine Conservation Zone

MDAC
Methane Derived Authigenic Carbonate

MDBRT
Measured Depth Below Rotary Table

MEI
Major Environmental Incident

MER
Maximising Economic Recovery

mgl^{-1}
Milligrams per Litre

mm
Millimetre

MMO
Marine Mammal Observer

mmobe
Million Barrels of Equivalent

ms^{-1}
Metres per Second

MSFD
Marine Strategy Framework Directive

MW
Megawatt

MWA
Mid Water Arch

N
North

NCMPA
Nature Conservation Marine Protected Area

NGL
Natural Gas Liquids

nm
Nautical Mile

NNS
Northern North Sea

NO_2
Nitrous Oxide

NO_x
Nitrous Oxides

NUI
Normally Unmanned Installation

NVP
Net Present Value

OBM
Oil Based Mud

OESEA
Offshore Energy Strategic Environmental Assessment

OGA
Oil and Gas Authority

OGUK
Oil and Gas UK

OMS
Operating Management System

OPEP
Oil Pollution Emergency Plan

OPRED
Offshore Petroleum Regulator for Environment and Decommissioning

OSCAR
Oil Spill Contingency and Response

OSDR
Offshore Safety Directive Regulator

OSPAR
Oslo-Paris

OSRL
Oil Spill Response Limited

PAH
Polycyclic Aromatic Hydrocarbons

PIP
Pipe-in-Pipe

PM
Particulate Material

PMF
Priority Marine Feature

POB
Person on Board

ppb
Pounds per Barrel

ppm
Parts Per Million

psia
Pounds Per Square Inch Absolute

PSV
Pressure Safety Valves

PTS
Permanent Threshold Shift

PW
Produced Water

Q
Quarter

RBA
Risk Based Approach

rms
Root Mean Square

ROV
Remotely Operated Vehicle

SAC
Special Area of Conservation

SAL
Single Anchor Loading

SCANS III
Small Cetaceans in European Atlantic waters and the North Sea

SCR
Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015

SFF
Scottish Fishermen's Federation

SL
Source Level

SNMP
Scottish National Marine Plan

SNS
Southern North Sea

SO_2
Sulphur Dioxide

SOSI
Seabird Oil Sensitivity Index

SO_x
Sulphur Oxides

SPA
Special Protection Area

SPL
Sound Pressure Level

t
Metric Tonne

t/d
Metric Tonnes per Day

THC
Total Hydrocarbon Concentration

TPOSA
Transportation and Processing Operating Service Agreement

TTS
Temporary Threshold Shift

TVDSS
True Vertical Depth Subsea

TVP
True Vapour Pressure

UHB
Upheaval Buckling

UK BAP
UK Biodiversity Action Plan

VDC
Vorlich Drill Centre

VHF
Very High Frequency

VOC
Volatile Organic Compounds

WBM
Water Based Mud

µm
Micrometre

1. INTRODUCTION

1.1 Overview

This Environmental Statement (ES), including an environmental impact assessment (EIA), has been prepared on behalf of BP Exploration Operating Company Limited (BP) for the proposed development of the Vorlich field. The Vorlich field was discovered in 2014 and spans Ithaca Energy (UK) Ltd operated Block 30/1f (previously operated by GdF SUEZ) and BP operated Block 30/1c UPPER (hereon referred to as 30/1c) of the Central North Sea (CNS); approximately 241km east of the Scottish mainland and 23km west of the UK/Norway median line (Figure 1 1).

The proposed development will comprise of:

- Two production wells tied-back to the Stella FPF-1 floating production unit (hereon referred to as FPF-1); and
- An export production pipeline installed between the Vorlich drill centre and FPF-1.

It is currently planned to drill the first well in Quarter (Q) 2 of 2019 followed by manifold, pipeline and umbilical installation in Q2 2020.

1.1.1 Location

The Vorlich drill centre is located in Block 30/1c of the CNS. The FPF-1 installation is located in Block 30/6a, approximately 10km south of the Vorlich field. The development does not overlap any marine conservation or environmentally sensitive areas. The closest marine conservation areas are the Fulmar Marine Conservation Zone (MCZ) and East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA), approximately 18km to the south and 30km to the north west, of the development. Coordinates are presented in Table 1-1.

Table 1-1 Project coordinates

Structure	Easting (E)	Northing (N)	Latitude (N)	Longitude (E)
Vorlich drill centre	443 415.00	6 303 190.00	56° 52' 03.92" N	002° 04' 18.65" E
FPF-1	445 333.00	6 293 763.00	56° 46' 59.91" N	002° 06' 19.16" E

Note: Datum used, ED50

1.1.2 Field Operatorship

The proposed Vorlich development is within the Greater Stella Area (GSA) development. The GSA consists of the Stella and Harrier fields which lie within Block 30/06a.

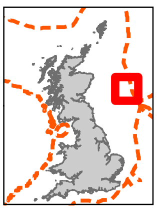
This ES documents the proposal for the Vorlich development; the proposed concept being a subsea tie-back to the FPF-1 Installation.

BP holds an 80% interest in Block 30/1c (Licence P363); Ithaca Energy hold a 20% interest in Block 30/1c and 100% interest in Licence Block 30/1f (Licence P1588). As per the Pre-Development & Pre-Unitisation Agreement, post unitisation equity has been agreed with BP at 66% and Ithaca at 34%.

In order to support development of Vorlich, BP as field operator will procure and install equipment related to the drilling of the production wells and installation of the xmas-trees. Ithaca, on behalf of the Stella Owners, will procure, install and commission the pipeline and associated topside modifications. Petrofac are the nominated Duty Holder of the FPF-1 Installation, with Ithaca as licenced Operator, on behalf of the Stella Joint Venture and Partners as per The Offshore Installations (Safety Case) Regulations 2005.

Legend

- Producer 1
- Producer 2
- Vorlich Drill Centre
- FPF-1
- Vorlich Pipeline
- Well
- Platform
- FPSO
- Cable
- Pipeline
- Median Line
- Licence Block
- Hydrocarbon Field
- Potential Submarine Structure within Pockmark
- NCMPA
- MCZ



NOTE: Not to be used for Navigation

BP EXPLORATION OPERATING COMPANY LIMITED

Figure 1-1: Location Overview

Date	Wednesday, March 7, 2018 09:51:10
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	CDA, OSOD, JNCC, ESRI, TCE
File Reference	J:\P2206\Mxd\ Location_Overview_v2.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Kerri Gardiner

0 6 12 18 24 30 km

1.2 Scope and objectives of the ES

This ES, and EIA, supports the development of Vorlich under the requirements of:

- The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017;
- The Offshore Petroleum Activities (Conservation of Habitats) (Amendment) Regulations 2017; and.
- The Conservation of Offshore Marine Habitats and Species Regulations 2017.

This ES reports the results from the EIA which was conducted to evaluate the environmental impacts of the Vorlich development. These potential impacts include physical presence of vessels; generation of atmospheric emissions; underwater noise changes; marine discharges; seabed footprint; and un-planned events. The EIA also considers socio-economic impacts such as impacts on fishing, shipping and other marine users.

See Appendix A for institutional policy and regulatory frameworks.

The ES covers:

- Drilling of 2 production wells;
- Installing a 10km 8"/12" pipe-in-pipe production pipeline and a static umbilical, between Vorlich drill centre manifold and FPF-1; and
- Operation and production from the field until 2030, with best-case production profiles demonstrating a 10 year field life.

Decommissioning activity at the end of field life will be subject of a further EIA.

1.3 Report structure

This ES is divided into the principal sections outlined below:

- Non-technical summary – The aim of the non-technical summary is to provide a high-level description of the project, baseline environment, the conclusions of the EIA, mitigation proposed and the overall conclusion of the ES in a short and concise form.
- Environmental statement – The main report which presents the findings of the EIA. It is subdivided into eight chapters as described in Table 1-2.
- Appendices – These include additional information and data supporting the EIA. It is subdivided into four sections as described in Table 1-3.

Table 1-2 ES report structure

Chapter	Title	Brief description of content
1	Introduction	This section establishes the context for the project and the ES. It provides information on the developer, the project location and design and scope of the EIA.
2	Development of the Project and Alternatives	This section provides an overview of the alternatives considered during concept selection.
3	Project Description	This section provides the basis upon which prediction and evaluation of the environmental and human impacts is conducted. It is split into the following subsections: ▪ Schedule; ▪ Construction Activities; ▪ Production; and

Chapter	Title	Brief description of content
		▪ Decommissioning.
4	The Baseline Environment	This section discusses the prevailing or existing conditions for the development area (physical, biological and human).
5	Approach, Impact Assessment and Mitigation Measures	This section describes the footprint of planned project activities, their potential effects on the environment and where possible quantifies the risk they represent, taking in to consideration mitigation where appropriate. Accidental events are also discussed.
6	Environmental Management	This section provides details on how BP will manage the environmental risks associated with the proposed development and a summary of environmental commitments.
7	Conclusions	A concise summary of the key findings of the EIA.
8	References	Sources of baseline information.

Table 1-3 Appendices content

Appendix	Title
A	Policy and legislation framework
B	Schematics
C	Consultation
D	HSE policies

1.4 Availability of the ES

A digital copy of this ES is available on request from:

BP Exploration Operating Company Limited

Clare Sloan

1 Wellheads Avenue

Dyce

Aberdeen

AB21 7PB

Email: Clare.Sloan@uk.bp.com

2. PROJECT JUSTIFICATION AND ALTERNATIVES

2.1 Overview

BP's North Sea strategy is to reduce risk, sustainably drive efficiencies, improve recovery from large reservoirs and to invest efficiently in new options. This is aligned with the Oil and Gas Authority (OGA) Maximising Economic Recovery (MER) UK Strategy. The proximity of Vorlich to key infrastructure will enable rapid development of the resource and aligns with the regional strategy.

In 2015, the Vorlich prospect was evaluated within BP Projects portfolio and an updated integrated subsurface description was completed during the concept development phase. The opportunity was re-evaluated to identify technically and economically feasible options that would allow development of the field and the potential host options.

Across all stages of concept assessment, as part of the BP concept selection process and selection criteria, the Vorlich development was assessed against numerous criteria to facilitate and document decisions transparently and align with the development objectives. The concept selection criteria are based on BP Global Projects Organisation (GPO) standard shareholder objectives. These objectives are developed from standardised criteria used within GPO to provide consistency in decision making across projects. An initial view of project decision criteria was developed within a business framing workshop in March 2015. A decision workshop was later conducted in February 2016, utilising the selection criteria included in Table 2-1, below. The strength of the decision-making process is driven through using a multi-disciplined approach to promote a holistic and robust concept. This includes mandatory representation from Heath, Safety, Security and Environment (HSSE), engineering, wells and operations.

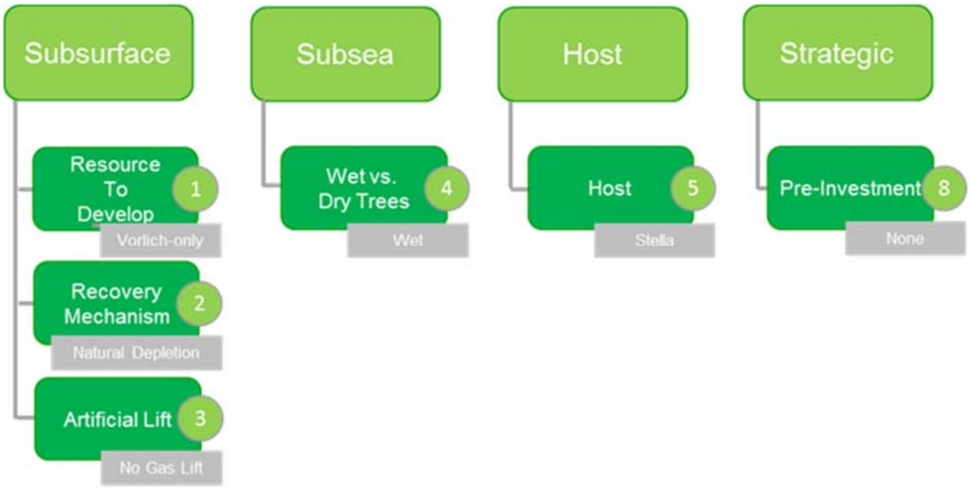
Each of these criteria are evaluated for each alternative option, Figure 2-1 outlines the Tier 1 decisions made during the concept development of Vorlich and the proposed concept for each Tier 1 decision. This section demonstrates how the selection criteria were applied to different options available for Vorlich development and provides justification for the proposed concept.

Table 2-1 Vorlich concept selection criteria

Objectives	Selection Criteria
Safety and Operating Risk	▪ Inherently safer design ▪ Major Accident Hazards
Environmental and Social Management	▪ Produced water discharge ▪ Associated flaring ▪ Chemical use and discharges ▪ Social impacts, economic resettlement
Operability	▪ Life of Field Assurance risks ▪ Sand and souring management ▪ Host Capacity Ullage ▪ Operating efficiency and track record ▪ Operation complexity (including multi-centre complexity) ▪ Host Cessation of Production (CoP) and risk exposure
Project Execution	▪ Brownfield complexity, scope and constructability ▪ Man hours, person on board (POB) requirements ▪ Stability & Structural suitability

Objectives	Selection Criteria
	▪ Flow assurance impact ▪ Timing/ schedule to support first oil
Subsurface	▪ Flexibility to accommodate subsurface uncertainties ▪ Reserves Opportunity
Financial	▪ Net present value (NPV)/ Capital expenditure (CAPEX) (Gross)) ▪ Tariffs and associated costs ▪ Partner agreements and alignment ▪ Effect of option on CoP/ Field Life ▪ Access to export route

Figure 2-1 Tier 1 decision flow chart



Note: Decision reference 7 & 8 are not applicable to the subject of this ES.

2.1.2 Subsurface and subsea alternatives

Using the Vorlich concept selection criteria against the Tier 1 options outlined in Figure 2-1, the decision outcome and justification of the selected concept is summarised in Table 2-2. This outcome is then discussed against the different host options available to the Vorlich development in Section 2.2.

Table 2-2 Decision outcome summary and selection criteria

Decision	Outcome/ preferred concept	Justification
Which resource should be developed?	Vorlich only	Vorlich only development provides economic return on investment due to the proximity to infrastructure which allows for rapid development of the resource. See Section 2.2 for further details on Vorlich only development justification.
Number of wells?	Two production wells	▪ A two producer development offers the most economic option. This allows significant production acceleration and it also provides mitigation against potential compartmentalisation. ▪ Two producer wells provides de-risking of potential well failure.
What will be the recovery mechanism?	Natural depletion	▪ Natural depletion yields the lowest cost, highest value, and least subsurface and brownfield risk. Reduces water handling for host.
Is an artificial lift required?	No gas lift	▪ Due to high gas oil ratio, fluid volatility and sand production, gas lift would have been the only feasible recovery mechanism.

Decision	Outcome/ preferred concept	Justification
		▪ Reservoir development studies determined little additional benefit with the application of a gas lift for Vorlich and therefore the decision to exclude gas lift from the project scope was taken. ▪ Gas lift would mitigate any risks of liquid loading however this risk is deemed low and for later field life and does not provide sufficient justification to implement.
Will wet or dry trees be used?	Wet (Subsea)	▪ A subsea, wet tree, solution at the Vorlich drill centre represents an inherently safer design compared to a normally unmanned installation (NUI) (dry) trees. ▪ A NUI would reduce brownfield complexity on the selected third-party host and was evaluated against all host options. Feasibility studies indicated that the topsides equipment required for the Vorlich tie-back can be accommodated by host options without incurring excessive brownfield modifications. ▪ Regular access to the wells for intervention purposes is not required and therefore there is no requirement for a dry tree.

2.2 Host options

Vorlich is a volatile oil discovery in the CNS located 60km south from the nearest BP operated asset Eastern Trough Area Project (ETAP). Based on its proximity to existing infrastructure, the development concept for Vorlich supports accelerated development of the resource whilst greatly enhancing project feasibility and economics, and fully aligns with the aims described in Section 2.1. A full suite of appraisal and subsurface work was completed and screening of alternative development options undertaken. This concluded, that based on the technical and commercial factors associated with field appraisal, a tieback to a third-party host was the preferred development concept. A larger development, i.e. standalone or floating installation, was not determined to be economically viable based on Vorlich only reserves. Other host options (including ETAP) were also evaluated and represent both sub-optimal economics and operability/ technical viability issues due to flow assurance risks.

The concept screening process shortlisted the host options for Vorlich to two tie-back candidates, the Shell operated Shearwater facility and the Stella FPF-1 installation. Table 2-3 provides an overview of the host selection and the key factors that determined the selection of the FPF-1 as the preferred host over the Shearwater facility.

Table 2-3 Output from Host selection comparative assessment

Criteria	FPF-1 over Shearwater Host Option
Safety and Operational Execute/ Operate Risks	▪ There were no safety or operational risks that were determined to significantly impact or dismiss either Host selection.
Environmental and Social Impact	▪ Reduced environmental impact from reduction in seabed disturbance flowline required with FPF-1 option over Shearwater (12km vs. 20km) ▪ Associated air, water, waste emissions with the Host selection were not determined to significantly differ between either option.
Operability (incl. structural)	▪ Reduced topsides process complexity and a newly refurbished topsides design. ▪ Availability of spare reception train via FPF-1 host supports operability of Vorlich production. This has been evaluated against the topsides modifications for natural gas liquids (NGL) handling that would not be required for Shearwater host. ▪ FPF-1 as a newly operated facility has less operational efficiency data currently available in comparison to Shearwater.
Project Execution	▪ FPF-1 plant layout supports access for modifications (plant layout is accessible/areas are easily identifiable for NGL modifications/ chemical injection skid).

Criteria	FPF-1 over Shearwater Host Option
	▪ FPF-1 option supports 2019 field drilling/ installation activity supporting project execution within prospective timelines.
Subsurface	▪ Both options demonstrate advantages/ disadvantages within subsurface uncertainty and flow assurance however the NGL option at Stella is determined to mitigate potential risks of Stella host.
Finance/ Commercial	▪ FPF-1 offer represents improved economics for development, primarily based on CAPEX for execution of project scope. ▪ Opportunity for using existing planned shutdown, reducing risk of Vorlich dedicated shut-down and associated costs whilst maintaining target first oil delivery dates.

2.3 Additional concept decision options

The Vorlich development will continue to complete option decisions based on the criteria provided in Table 2-1 throughout detailed engineering design. Based on feedback from recent stakeholder engagements (see Appendix D - Consultation), the pipeline installation methodology has also been included within this section with the associated justification. This is shown in Table 2-4, below.

Table 2-4 Pipeline installation selection

Selected Concept	Justification
Pipeline Installation method: Trenched and backfilled, target depth 1.5m.	Trenched and backfilled and surface lay options reviewed. Trenched option selected on the basis of: ▪ Offers long term protection, stability and mitigation to disturbance risks for production flowline/ controls umbilical. ▪ Aligned with existing Stella and Harrier pipelay philosophy. ▪ Scottish Fishermen's Federation (SFF) consulted and preference indicated as trenched and backfilled. ▪ Rock protection or mattress requirements are discussed in Section 3.6.4.2. Quantities will be finalised and permits submitted (e.g. Deposit Consents). Associated impacts have been evaluated and assessed within this EIA based on a conservative assumption and are discussed in Section 5.6.

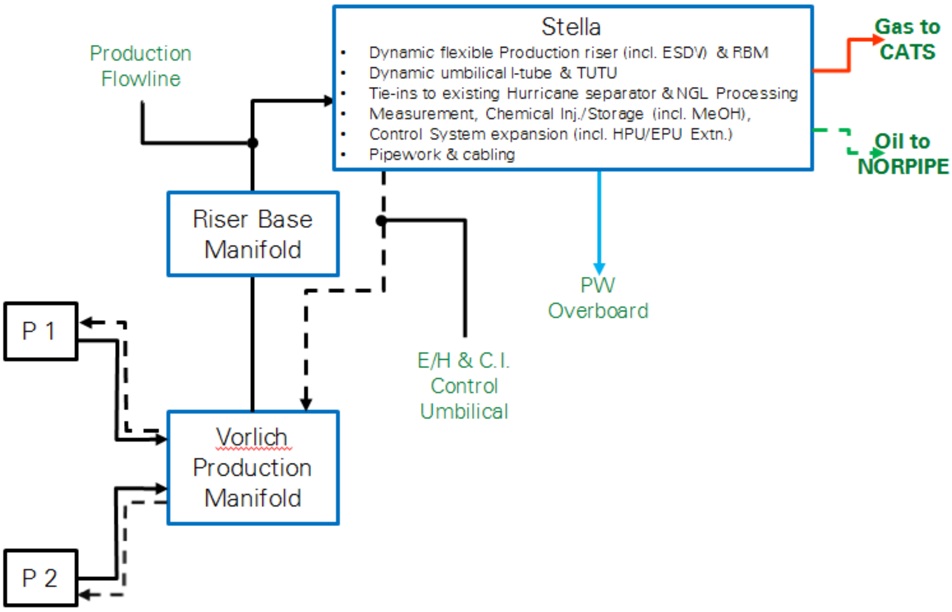
2.4 The proposed concept

The selected concept is a two-producer natural depletion subsea development via the Stella development (see Figure 2-2). Export to market will be through the Norsea terminal and CATS.

The project has selected the FPF-1 floating production unit as the 3rd party host for the Vorlich development as it represents the concept with:

- Opportunity for production acceleration (no ullage restrictions);
- Enables export of all the NGLs via new retrofit NGL recovery facilities;
- Dedicated existing high-pressure inlet separator for Vorlich with individual field hydrocarbon measurement in place. Shared low pressure separation into existing operating oil & gas processing facilities;
- Oil Export pipeline for Vorlich liquids export & gas export via CATS system;
- Enabler to first oil delivery in Q3 2020; and
- Project schedule.

Figure 2-2 Vorlich over Stella FPF-1 development concept



3. PROJECT DESCRIPTION

3.1 Overview

The project description provides an overview of the proposed activities to be undertaken during the construction, commissioning, production phases of the Vorlich development and the associated timeframe (Figure 3-1).

Figure 3-2 shows the field before development and Figure 3-3 shows the field after the Vorlich development. The subsea development will comprise of two wells at the Vorlich Drill Centre (VDC), connected onto a manifold structure located adjacent to the wells. The drill centre will be connected back to the FPF-1 with a 10km 8"/12" pipe-in-pipe production pipeline and a static umbilical.

3.1.1 Scottish Marine Plan

The Vorlich development is in the area covered under the Scottish National Marine Plan which “sets out strategic policies for the sustainable development of Scotland’s marine resources out to 200 nautical miles” (The Scottish Government 2015). Oil and gas exploration and development activities are covered by six marine planning policies. Of these, the following are considered relevant for the proposed activity and the planned operations are aligned with these policies:

- OIL & GAS 1 - ensure that the level of environmental risks associated with oil and gas activities are regulated;
- OIL & GAS 3 - infrastructure should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints; and
- OIL & GAS 6 - Operators should have sufficient emergency response and contingency strategies in place) are considered relevant for this.

In addition to the oil and gas policies, the Vorlich development has been assessed against general policies and objectives and Good Environmental Status (GES) description, details of which can be found in Appendix A – Policy and Legislative Framework.

3.1.2 Development overview

The Vorlich discovery is a circa 34 million barrels of oil equivalent (mmboe) (mid-case recoverable) volatile oil discovery located in Blocks 30/1c and 30/1f of the CNS. The Vorlich fluid is a volatile oil with high levels of NGL. The field will be produced as an oil and gas subsea tieback development to a host facility. The proposed timing and scope for the Vorlich development permits that the gas and liquids can be processed within the existing capacity of the Stella FPF-1 floating production unit without major modifications to processing facilities. However, in addition to the drilling of the production wells (to be delivered by BP), to support and maximise production new subsea infrastructure and topside modifications for NGL processing (both scopes delivered by the Stella Owners) is required. Processing capacity for Vorlich fluids will be available by 2020, as per commercial offer received and subsequent Transportation and Processing Operating Service Agreement (TPOSA).

The proposed Vorlich development can be summarised as follows:

- Drilling of two-producer wells from the VDC within the GSA Development and associated wellheads.
- Installation of a new production manifold at the VDC.
- Installation of a new, surface laid 10km 8" pipe-in-pipe (PIP) production flowline.
- Installation of a new, surface laid 10km control umbilical and tree controls.

- Installation of riser base hardware, including mid-water arch.
- Review of potential modification requirements to existing topsides facilities.

This is summarised in Figure 3-2 and Figure 3-3.

3.1.3 Facilties accountability and ownership

Subsea and topsides facilities to process Vorlich fluids over the FPF-1 facility will be provided by the Stella Owners. Stella Owners will be accountable for the design, procurement, installation and commissioning of all Vorlich facilities. This includes topsides modifications. The exception is regarding subsea trees and wellheads which will be delivered by BP. Controls systems hardware for the trees will be free issued from Stella to BP for integration and testing by BP prior to deployment as part of the drilling operations.

The FPF-1 "Duty Holder" is Petrofac Engineering and Production Services West is the installation operator of the FPF-1.

3.1.4 Drilling accountability and ownership

The two Vorlich production wells will be drilled by BP as the Vorlich Operator. The scope and key interfaces will be further described in a Construction & Tie-In Agreement (CTIA).

3.1.5 Project schedule

Offshore drilling activities are planned to commence during Q2 of 2019; first oil from Vorlich is anticipated in July 2020 and the end of field life is expected to be in 2030. Indicative key milestones for the development are listed in Figure 3-1. These are based on current plans and may be subject to change on finalisation of the project design.

Figure 3-1 Project schedule

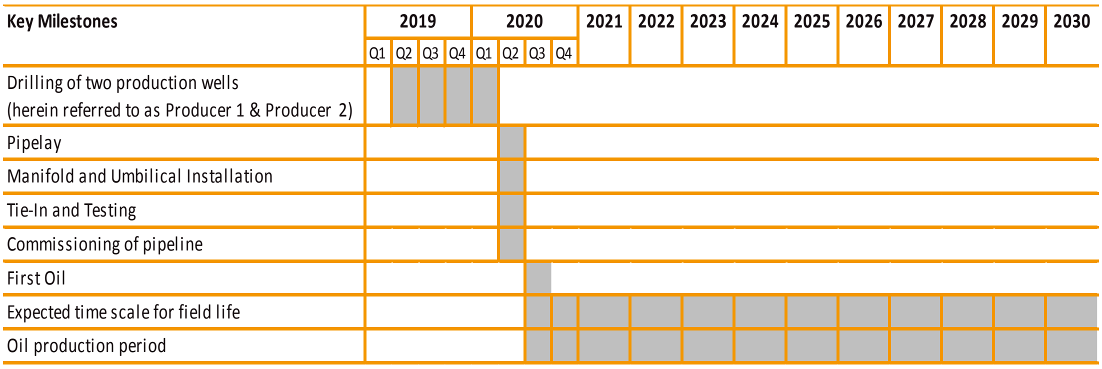


Figure 3-2 Field before Vorlich

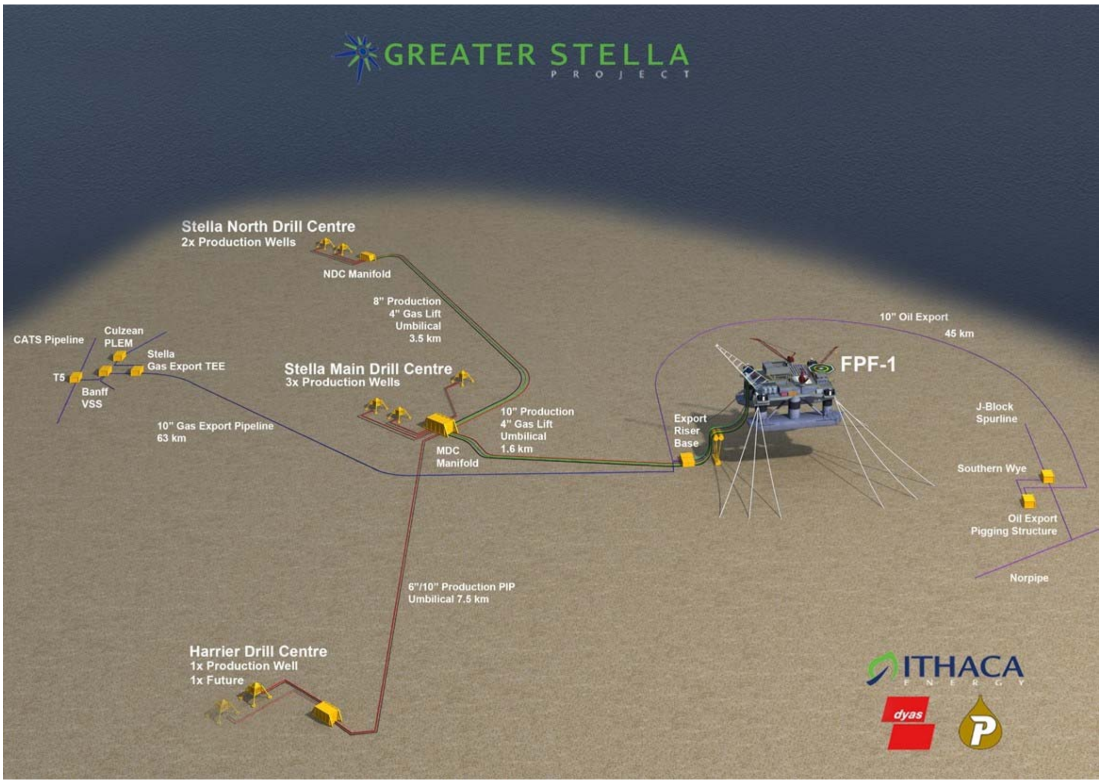
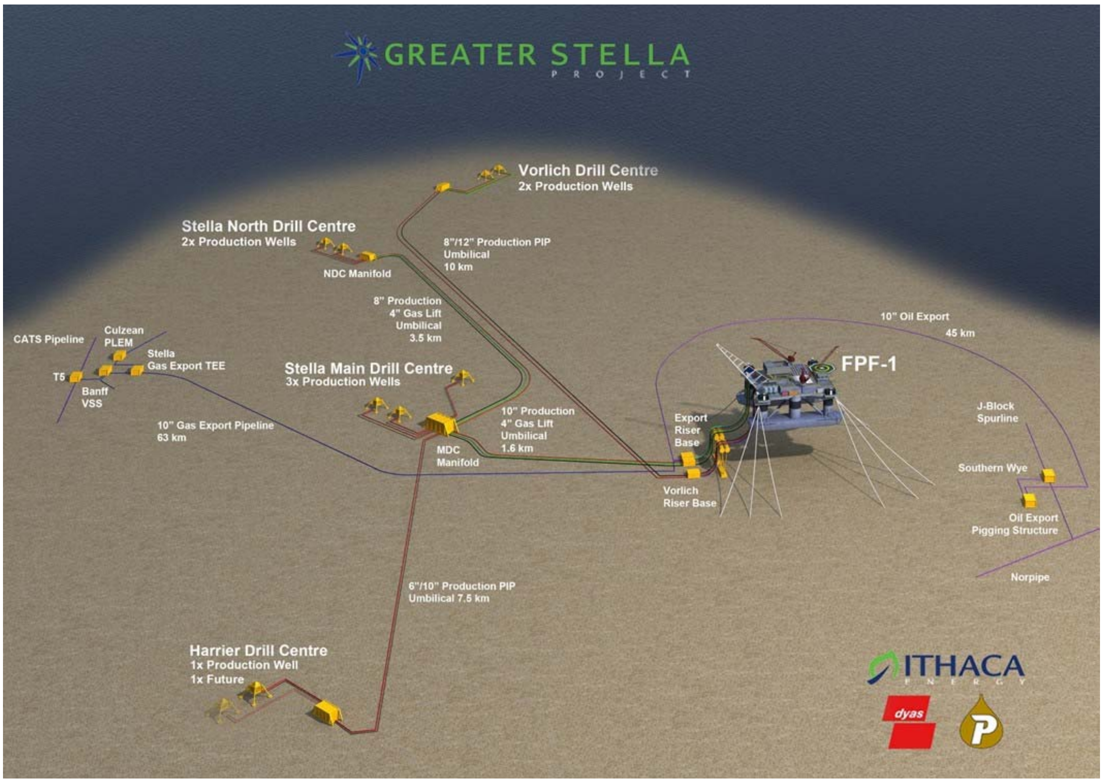


Figure 3-3 Field after Vorlich

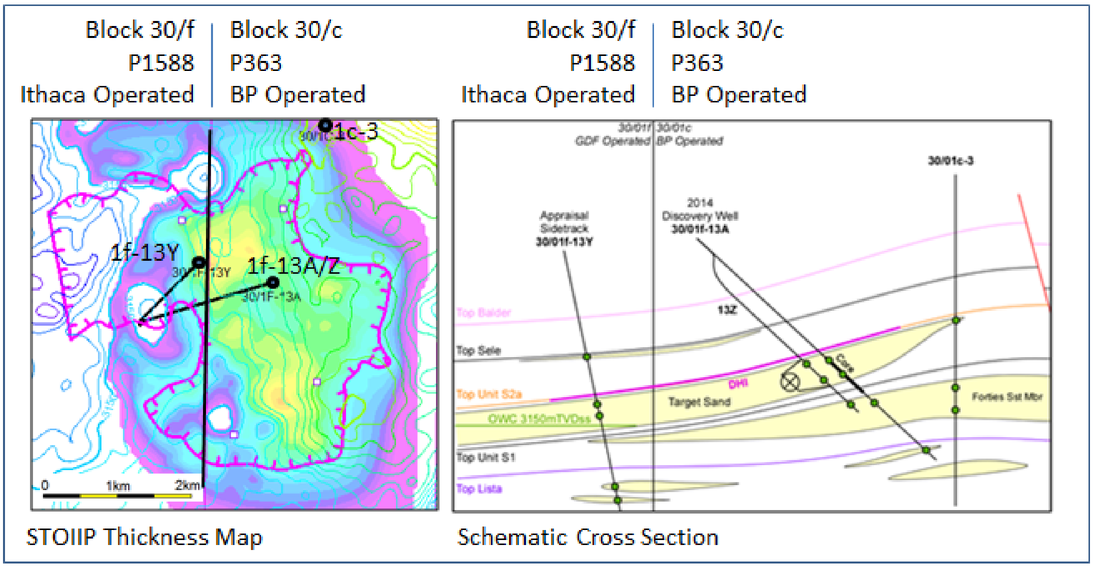


3.2 Field and reservoir characteristics

The Vorlich reservoir unit is a Lower Palaeocene distal deep marine turbidite sand sitting stratigraphically above the Forties Sandstone Member. The field is trapped within an unfaulted, gentle one way dip, three way stratigraphic closure with a total column height of 60m.

Vorlich was originally "discovered" in 1984 by the 30/1c-3 well and "rediscovered" in 2014 when better seismic imaging and the integration of the 30/1c-3 well enabled an improved regional understanding. This led to the drilling of the 30/1f-13A well and its side tracks, 30/1f-13Z/Y. The field is fully appraised with four well penetrations in conjunction with a seismic amplitude anomaly.

Figure 3-4 Vorlich appraisal well locations and licence boundary



Overall, the Vorlich reservoir has relatively simple geology. Rock properties are favourable with high net to gross reservoir thickness.

Vorlich produced gas contains an unusually large amount of NGL. The Vorlich gas composition is shown to have material abundance in the C3+ hydrocarbon component range. This lends itself to considerable liquids extraction during further topside and midstream processing.

The Vorlich reservoir fluid properties are summarised in Table 3-1:

Table 3-1 Vorlich reservoir fluid properties

Property	Value
Reservoir Depth	3150 (mTVDSS)
H_2S	3ppm
CO_2	1.8% mole
Initial Reservoir Pressure	4,860 psia
Reservoir Temperature	138˚
GOR	3000scf/bbl
Zero Flash Gravity API	44.9
Wax content	4 wt%
Asphaltene Content	<0.05 wt%
Max Pour Point	<-51˚C

3.3 Production profiles

First oil is currently anticipated to be Q3 2020. Economic cessation of production is in 2027 (reference case), with the lower-case and upside-cases being in 2026 and 2030 respectively. The reference production profile assumes 80% operations efficiency for design.

The Vorlich wells are expected to produce a peak rate of 1566 tonnes oil and 1.9 million m^3 gas (reference case) and 1827 tonnes oil and 1.9 million m^3 gas (upside-case) in the first full year, gradually reducing throughout field life; see Table 3-2 and 3-3 for reference case and best-case production estimates. For emissions profiling, an upside, peak case will be assessed when determining worst-case emissions profiles.

Table 3-2 Vorlich Production Profiles – reference case

Year	Reference Case Oil Production tonnes/day	Reference Case Gas Production m^3/day	Peak Rate Oil Production tonnes/day	Peak Rate Gas Production m^3/day
2020	838.6	573642	1148.8	785811
2021	1253	1510165.68	1566.3	1887707.1
2022	634.2	1486086.88	792.8	1857608.6
2023	345.8	1288924	432.3	1611155
2024	212.8	1090628	266	1363285
2025	135.8	842758	169.8	1053447.5
2026	96.6	646161.68	120.8	807702.1
2027	61.6	418121.28	77	522651.6
2028	11.2	71103.28	14	88879.1
2029	1.4	7365.28	1.8	9206.6
2030	0	1982.96	0	2478.7
Total	**3591**	**7936939.04**	**4589.6**	**9989932**

Table 3-3 Vorlich Production Profiles – upside-case

Year	Upside-Case Oil Production tonnes/day	Upside-Case Gas Production m^3/day	Peak Rate Oil Production tonnes/day	Peak Rate Gas Production m^3/day
2020	858.3	575877.7	1175.7	788873.5
2021	1461.7	1511584.8	1827.1	1889481.0
2022	810.9	1511582.1	1013.7	1889477.6
2023	546	1511582.9	682.5	1889478.6
2024	380.5	1439445.5	475.6	1799306.9
2025	260.4	1253154.7	325.4	1566443.3
2026	190.7	1089595.8	238.3	1361994.7
2027	140	894186.9	175	1117733.6
2028	116.2	785095.8	145.2	981369.8
2029	92.1	627329.4	115.1	784161.7
2030	34.8	233453.8	43.5	291817.2
Total	**4891.4**	**11432889**	**6217.1**	**14360138**

Table 3-4 Vorlich Production Profiles – reference cases

Sales Products	Deterministic Cases		
	Lower-case YE26	Reference YE27	Upside-case YE30
Sales Gas (m^3)	1,871,743,560	2,355,961,636	3,454,655,284
Fuel Gas (m^3)	300,158,574	348,297,213	472,891,338
NGL (mmstb)	4.7	6.1	8.7
Oil equivalent (mtoe)	3.6	4.7	6.8
Oil Equivalent (m^3)	4131.7	5355.3	7675.4

3.3.2 Produced water profiles

There is no anticipated water production volume as part of the Vorlich development. Additional flow assurance is being conducted using conservative assumptions of water breakthrough from 2026. Formation water will be managed through the existing capacity of the FPF-1 installation (see Section 3.5.5).

3.4 Wells and drilling

3.4.1 Well programme

The assumption at this time is that the wells will be batch drilled (drilling of multiple wells from a single location) between 2019 and 2020.

3.4.2 Well location

Table 3-5 presents indicative coordinates for the location of the two Vorlich production wells along with the estimated well depth and length. The well locations and field layout are provided in Figure 3-3 and a more detailed layout is presented in Appendix B - Schematics. Producer 1 and Producer 2 are both high pressure / high temperature wells.

A geotechnical desktop study was conducted in 2017 to determine the optimum drilling location, manifold foundation design and flowline stability and trenching requirements. A geotechnical and geophysical survey of the pipeline route and drill centre location was completed in 2017. No significant safety or environmental issues were identified (Fugro 2017). The final positioning of the well locations within the boundaries of the established drill centre has not yet been confirmed and may be influenced by a planned shallow gas assessment based on the reprocessing of the seismic data, however the movement is not expected to be material.

Table 3-5 Well location

Target	Northing (m)	Easting (m)	Latitude	Longitude	Well depth (m) MDBRT[1]	Well length (m)
Producer 1	6303625	443017	56° 52' 17.811 N	2° 3' 54.798 E	4600	4350
Producer 2	6302501	443407	56° 51' 41.638 N	2° 4' 18.727 E	4400	4150

[1]MDBRT = measured depth below rotary table

3.4.3 Drilling template

A drilling template, a steel frame with slots for each well and supporting legs that is lowered down and anchored to the sea floor. will be used at the VDC. Full details of template design are not currently available. These will be incorporated into the drilling permit applications.

3.4.4 Drilling rig

The production wells will be drilled from a single drill centre 10km north of the FPF-1 host facility using a cluster manifold architecture that will enable drilling from a semi-submersible rig. It is anticipated that drilling operations will commence in Q2 2019. The final decision on the exact semi-submersible will be made at a later stage of the project planning process. Any adjustment to the final well location will be addressed during permit application to undertake drilling operations.

To support drilling operations, the following systems and services will be located onboard the selected rig:

- **Bulk Storage**; for fuel oil, bulk mud and cement, liquid mud, drill water and potable water.
- **Pipe and Materials Storage**; covered storage will be provided for sacked material, drilling equipment, spares etc. and deck storage for drill pipe casing.
- **Helideck**; a platform on the semi-submersible rig which allows helicopters to land and take off.
- **Craneage**; two cranes provided for loading/off-loading equipment and supplies from vessels.
- **Environmental Protection**; sewage treatment unit and hazardous and non-hazardous drainage systems (which collect rainwater and/or any minor spills to a drains tank for treatment prior to discharge to sea, or allow transfer to tote tanks for shipment to shore and disposal by licensed waste disposal contractors).
- **Well control**; technique used during drilling operations to maintain fluid column hydrostatic pressure to prevent fluid from entering the wellbore.
- **Blowout preventer (BOP)**; mechanical device used to seal, control and monitor oil and gas wells to prevent blow outs.

3.4.5 Well design

The Vorlich wells will be designed to be drilled from a subsea template. The final well design has not yet been completed, however it is anticipated that the wells will be a conventional five-hole section design with four-casing strings. The metal casing, slightly smaller than the well bore diameter, are placed in the hole to provide structural integrity and are held in place with cement (Section 3.4.6).

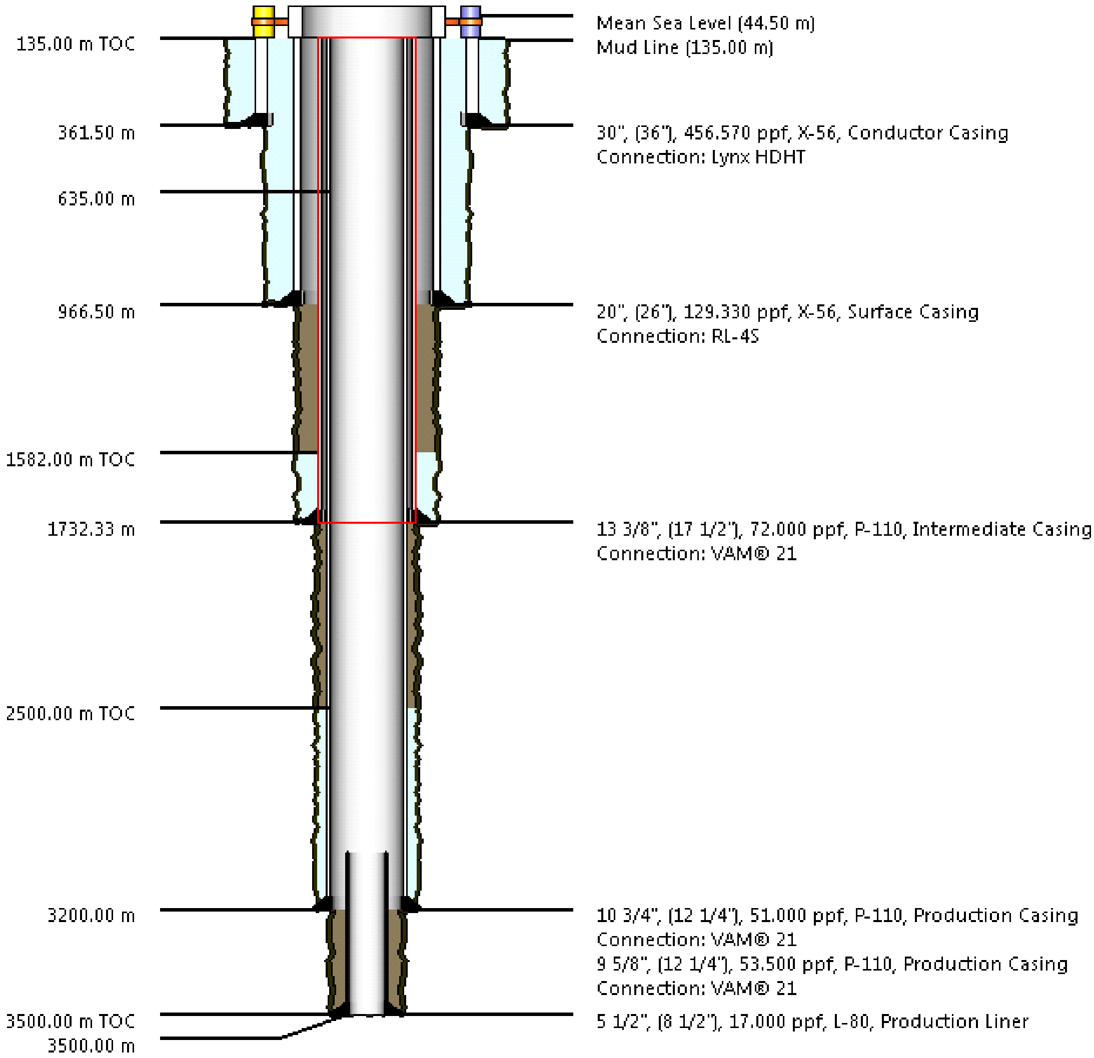
The bullets below set out an indicative well design, however this is potentially subject to change. The preliminary well design schematic is presented in Figure 3-5, below.

- The top-hole section will be drilled to circa 300 - 400m MDBRT. This section will be cased with a 30" conductor.
- A 26" section will then be drilled to 900 - 1000m MDBRT. This section will be cased with 20" surface casing.
- The marine riser and BOP will be installed onto the wellhead.
- A 17½" section will then be drilled to 1700 - 1800m MDBRT. This section will be cased with 13⅜” intermediate casing.
- The 12¼" section will be drilled to a depth of 3000 - 3200m MDBRT. The section will be cased with 10¾" x 9⅝" production casing.
- An 8½" section will then be drilled to the well target depth. The sand control lower completion will be installed over the reservoir section.

See Section 3.4.6 for more information on drill fluids and cuttings.

Figure 3-5 presents a representative figure of the drilling schematic for the Vorlich production wells. Due to the current stage of development of the well and reservoir data, this is a indicative figure only and is subject to change. The lower completion type will be either standalone screens or open hole gravel pack.

Figure 3-5 Representative well schematic



3.4.6 Drilling fluids and cuttings

Drilling fluids (also known as drilling muds) are used in offshore drilling activities. There are two types of drilling fluids; water based mud (WBM) and oil based mud (OBM). Drilling fluids are required for:

- Cuttings transportation from the wellbore to the surface;
- Lubrication and cooling of the drill bit;
- Maintaining hydrostatic pressure so that fluids do not transfer from/to the formation (well control); and
- Support and stabilisation of uncased wellbore.

Drilling fluids are pumped from the drilling rig through the drill string and the drill bit. From here they travel back up the annular space between the drill string and the sides of the wellbore. The circulating system is essentially a closed system with the mud recycled throughout drilling to the drilling rig where rock cuttings are removed from the drilling mud. At the end of drilling each section, where the mud cannot be recycled WBM is discharged to sea (under the terms of a Chemical Permit) and OBM is collected and contained on the rig and skipped and shipped to shore for processing and recycling. A range of products are typically added to the drilling fluids to address anticipated conditions downhole (e.g. viscosifiers, shale inhibitors, weighting agents), and to overcome difficult conditions (e.g. stuck drill pipe or loss of well pressure or fluid).

For the Vorlich wells it is planned that the top hole, 26" and 17½" sections will be drilled using WBM. All of the cuttings and the associated mud from the top-hole and 26" sections will be discharged continuously at the seabed as the sections are drilled. Cuttings and WBM from the 17½" section will be discharged at sea level from the drilling rig following installation of the riser. The 12¼" and 8½" sections will be drilled using OBM. The cuttings and OBM will be skipped and shipped to shore for recycling/disposal.

Estimated cuttings volumes are provided in Section 5.6.2.

3.4.7 Cementing

Casings will be fixed in place in each section by pumping cement into the well and forcing it into the space between the outside of the casing and the wellbore (known as the annulus).

Cement will be prepared and pumped into the wellbore to prepare the well for further drilling. There are two types of fluid prepared to undertake cementing operations; cement mixwater and cement spacer. Cement mixwater (water with soluble and suspended additives required to ensure that the cement has the correct properties) is pre-mixed in pits onboard the drilling rig before being mixed with cement solids to form a slurry which is pumped into the well. Cement spacer (fluids used to prepare the borehole to take cement) is similarly prepared in pits prior to starting a cementing operation.

Prior to cementing the tophole section cement spacer will be pumped directly into the annulus to ensure that any cement placed there gels up to maintain the structural integrity. The cement spacer used will contain a dye to ensure visibility of the cement spacer when it reaches the seabed. A rig based remotely operated vehicle (ROV) will be used to confirm that the cement has been placed correctly and to confirm when the spacer reaches the seabed. 100% discharge of the top hole cement spacer at the seabed is unavoidable.

Dead volumes (volumes in the pits not accessible to pumps during normal use), washings from the pits and washings from the cement mix tank are normally discharged to sea as part of the operation. In the event that cementing operations have to be aborted (i.e. it is either not possible to pump cement downhole or it is necessary to recirculate the cement out of the well) fluids contained in the mix pit, the contents of the cement mix tank and if applicable, returned cement will be discharged to sea (under the terms of a Chemical Permit).

3.4.8 Wellbore clean-up and completions

On completion of drilling operations, the wellbore is typically cleaned to remove any waste and debris remaining in the well in order to prevent damage to the pipeline or topside production facilities during production. The wellbore is cleaned using a series of chemical mixes as separate pills:

- Base oil – used to remove OBM residues from the borehole and help prevent any sludge build-up during water contact;
- Brine viscous pill containing a surfactant – used to displace OBM and base oil out of the hole;
- Detergent/collector spacer – used to dissolve any remaining residue or build-up on the metal surfaces of the wellbore;

- High viscosity brine – used as a spacer between the previous pill and the final completion fluid; and
- Completion fluid.

Where these clean up fluids are not suitable for discharge to sea e.g. due to their oil content or chemical toxicity, they will be shipped and skipped to shore. Low toxicity completion fluids e.g. high-density brines such as Sodium Chloride or Sodium Bromide brines may in some circumstances be discharged (under the terms of a Chemical Permit).

Following clean-up the production tubing (used to carry oil and gas from the reservoir up the well) and other elements of the completion such as a downhole safety valve will be installed. Sand screens will be installed to minimise sand production from the reservoir as far as possible.

At the end of the well some completion fluids are likely to remain in the well until the well is connected to the pipeline and associated production systems.

3.4.9 Well testing

Following completion of the well it may be necessary to carry out a well test to confirm the productivity of the well. This will typically involve the flaring of (burning off) crude oil and gas from the wells from a well test package on the rig consisting of sand control equipment, test separator and flare boom. The quantities of oil and gas which will be flared during the well test are not yet defined and may exceed the threshold (flaring over a period >96 hours or quantities exceeding 2000 tonnes) that require consent as an extended well test. Sand produced from the reservoir during the well test may be discharged although, given the duration of the test the quantities are unlikely to be significant.

3.4.10 Well interventions

Vorlich completions will be designed to facilitate interventions for reservoir surveillance purposes. However, no interventions are planned to address well equipment failure.

3.5 Overview of the Stella FPF-1

The FPF-1 was originally built in 1976/1977 as an eight-column twin hull vessel of an Earl & Wright Sedco 700 design. It subsequently operated as a service vessel for 10 years on the Ekofisk field. In 1989 the FPF-1 was converted into a floating production unit and the hull was modified to improve the vessel's stability for production facilities. In 2009, it was purchased by Petrofac and renamed the FPF-1 (Figure 3-6). The FPF-1 has been extensively refurbished, including the replacement of topsides processing facilities, and is currently operating as a hub for the development of the Greater Stella Area. The FPF-1 has a documented design and fabrication history, comprehensive structural protection systems and has undergone regular inspection and is classed by Lloyd's Register for operation in the North Sea. Several analyses of structural capacity have been completed in the past and further analyses have been carried out to support the deployment for life-of-field.

Figure 3-6 Stella FPF-1

The FPF-1 is a spread moored floating production facility and maintained on a set heading. The mooring system utilises a combination chain/wire rope arrangement from each corner column connected to chains fixed to the seabed by piles. All piles are located within Stella and Harrier licensee acreage. The installation is designed with flexible risers and umbilicals, with male/female underwater, mechanical connectors. The risers and flowlines have been installed over a single Mid Water Arch (MWA) for the Stella and Harrier facilities. A second MWA will be required to facilitate Vorlich.

The FPF-1 installation is planned to act as a hub for wider production from the Greater Stella Area

3.5.2 Facility operation: Oil and condensate systems

Hydrocarbons from the Stella and Harrier fields arrive at the topsides via a new 10" riser at approximately 20 to 30 barg. The riser is routed to a production manifold. The high pressure (HP)/ low pressure (LP) interface between the subsea and the topsides is managed by an instrumented overpressure protection systems (IOPPS) arrangement.

From the manifold, the pressure is reduced to the inlet heater and high-pressure separator. As arrival temperatures lower (start-up and later in field life), production fluids will be routed through inlet heaters and heated to approximately 70°C to ensure efficient separation, break emulsions and manage wax and hydrate formation.

The well fluids enter the three phase HP separators. The Stella and Harrier liquids are routed to the production LP separator. HP gas is routed to the gas export compression and dehydration system for further processing and exported via the gas export riser. LP gas is routed to the off-gas compression system, where the gas is compressed and co-mingled with the gas from the HP separator on route to the export gas compression and gas dehydration systems.

Stabilised oil is pumped out of the LP separator and cooled by oil from the HP separator in the oil pipeline heater. Final cooling of the oil takes place in the 2 x 100% duty product oil coolers.

Oil is exported to Norpipe via one of the 2 x 100% export oil pipeline pumps that raise the oil pressure to approximately 34-57 barg (depending on export rate). The crude oil flow rate is measured and recorded in the oil metering package prior to export via the oil export riser.

It is not expected that modifications will be required to the oil and gas condensate systems to host the Vorlich development.

3.5.3 Export and fuel gas compression and conditioning

The export compression facilities comprise 2 x 50% compression trains each consisting of three process stages on a single shaft, driven by a gas turbine.

From the HP separator, gas is routed to the export compression facilities, and split into two equal streams to the compressions trains. Gas enters the 1st stage and flows through the 1st compression stage. An aftercooler operates to lower the temperature of the gas.

Gas is then routed to the 2nd stage compressor suction drums and into the 2nd compression stage. 2nd stage compressor aftercoolers reduce the temperature of the gas to maximise the knock-out of NGLs and water upstream of the glycol contactor in knock-out drums. NGLs and water are routed back to the HP separators. Note, modifications to the NGL processing for the FPF-1 are discussed in Section 3.5.9.

From the 2nd compression stage, the two trains co-mingle and the combined gas stream is routed to a TEG contactor where it is dehydrated to the export specification. No mercury or carbon dioxide removal facilities are required as these can be treated onshore.

The flow is then split for a 3rd stage of compression. Following 3rd stage aftercoolers, the two trains once again merge and the combined export stream is routed through a fiscal metering package to the export riser. Methanol is available on the installation for purposes of prevention of hydrate formation.

Fuel gas is taken upstream of the 3rd stage gas compressor suction drum.

The addition of Vorlich fluids will not require any modifications to the export compression facilities. A new NGL facility will be required and more information is provided in Section 3.5.9.

3.5.4 Utilities

The FPF-1 has sufficient storage capacity for subsea chemicals, fuel oil, diesel oil, lube oil, and potable water. All storage areas are segregated from all plant and equipment by bumper bars of sufficient size to afford protection from deck cargo that is being transferred. Chemical storage and usage is in accordance with the vessel’s Control of Substances Hazardous to Health (COSHH) procedure and Material Safety Data Sheets are carried for all hazardous substances.

The diesel storage capacity is approximately 750m^3. In normal operation power generation is by fuel gas, and diesel fuel is only required in significant quantities when fuel gas is not available.

The FPF-1 is equipped with Integrated Control and Safety System (ICSS), subsea control system, compressor control system and compressor control system.

3.5.5 Produced water

Produced water is treated within the Produced Water Treatment System within the FPF-1 process capacity. This has a design handling capacity for 22,000bpd of produced water. The system consists of hydrocyclones and a produced water degasser vessel to achieve an oil in treated water content of less than 30ppm. Produced water is discharged to sea following treatment to reduce oil in water concentration to target concentrations (<15ppm). Based on existing permitted allowances, the maximum produced water discharge volume for 2018 (from Stella/ Harrier production) is estimated for 415m^3/day, reducing to 337m^3/day in 2019 (figures taken from OLP/404/1 Version 1).

There are no modifications required to the produced water treatment facilities for Vorlich.

3.5.6 Flaring and venting

Flaring is the controlled burning of natural gas during oil and gas operations. Venting is the controlled release of gases into the atmosphere. The FPF-1 has a HP and LP flare system. The HP flare system is designed to handle all HP sources; primarily pressure safety valves (PSVs) and blowdown vent piping from the hydrocarbon systems. The LP Flare system handles lower pressure releases, such as off-gas from the glycol regeneration system.

The Stella and Harrier fields have been developed with a minimum flaring philosophy. A Flare Gas Recovery Unit (FGRU) has been incorporated into the topside configuration. With FGR, the HP and LP flares are normally unlit, and include a ballistics type flare ignition package. The Flare (HP, LP flare & atmospheric vent) include ultrasonic meters. Vorlich fluids are not anticipated to impact the flare philosophy on the FPF-1; flow assurance for Vorlich is still on-going.

It is assumed for the purposes of this EIA (see Section 5.3) that one 96-hour flaring event will occur at Vorlich for each operational year; during which 1,175 tonnes of oil and 788,563m^3 gas will be flared per day. These volumes have been determined using current well test data and are considered conservative.

3.5.7 Power generation

Power during normal operation is supplied by three SGT300 Siemens gas turbine generators driving 6.6kV main power generators in an n + 1 configuration. The rated output of each generator is (at -7˚c) 8.5MWe. The power generation turbines run predominantly on fuel gas. Each turbine is fitted with a waste heat recovery unit which may potentially recover up to 4.7MW from each turbine for process heating. Each of the three units has dual fuel capability and can be run on diesel fuel in times of production outage or start-up.

During installation shutdown or black start situations when main power generation from the gas turbine generators is unavailable, one of the two emergency generators is used for auxiliary power with the second unit being available for emergency use and having the capacity to supply all emergency services.

No additional power requirements are required for Vorlich production.

3.5.8 Metering

Additional metering is not required on the Vorlich subsea xmas trees or production facilities. Single phase metering is provided topsides on the Hurricane HP separator which is to be dedicated to Vorlich production. If single well testing is required this can be achieved and will be managed during individual well start-up and shutdown.

3.5.9 Vorlich modifications to FPF-1

The Vorlich development will use existing (fixed) riser, reception facilities (inlet heater and separator) and produced water treatment facilities that were originally designated for the Hurricane field (a field located in the Greater Stella Area, see Figure 3-2). Minor modifications are required to allow for use of existing infrastructure (e.g. instrumented overpressure protection systems valve and trip settings, separator internals, metering and pressure safety valve settings). Ongoing flow assurance studies will confirm the extent of (valve) hardware and (control / shutdown set point) changes that may be required to the IOPPS. There are no modifications required to the produced water treatment facilities.

In order to process commercial quantities and debottleneck the existing system for Vorlich fluids, additional natural gas liquids (removal) capacity is required. The existing NGL processing facilities comprise of two stages of NGL stabilisation with interstage heating, an off-gas heater and 2x100% NGL booster pumps.

The new NGL facilities will produce a stabilised NGL product that meets the export pipeline true vapour pressure (TVP) specification. This stream will be spiked into the oil export stream upstream of the oil metering package. Gas will be recycled to the existing plant. Additional relief and blowdown facilities will be included. The NGL equipment will be located in an existing 'void' area in a central location of the FPF-1. The layout of the new NGL plant preserves access to the equipment that is located below. See Appendix B - Schematics for the new layout of the NGL plant.

Other than the modifications to the Hurricane reception facilities, no other brownfield modifications are required to major equipment. However, upgrades to the integrated control and safety system as well as instrument, electrical and piping and structural tie-ins will be required.

Additional combustion equipment onboard FPF-1 is not required.

Modifications which lead to an alteration to the potential environmental impact of FPF-1 are provided in Table 3-6.

Table 3-6 Environmental impact alteration

Activities	Environmental aspect	Potential impacts	Permit implications
Increased fuel use during flaring and start up and commissioning	Air emissions	Increased combustion products realised to the air. Potential deterioration in air quality resulting from release of NOx, SO_2, CO, VOC's.	PPC permit variation GHG/ EU-ETS permit variation Flare consent Increased ETS OPEX
Increased load demand	Energy use	Addition of power consumers plus increased production processing leading to increased fuel consumption.	PPC permit variation
Increased production fluids associated with increase in produced water discharges for scale discharges.	Surface water quality	Increased release of hydrocarbons, chemicals and potentially scale to the marine environment. This may have implications on water quality and marine biota.	Oil discharge permit variation/ best available technique (BAT) assessment Update to FPF-1 risk based approach (RBA) assessment
Spill risk	Unplanned release	Potential release of Vorlich oil to the marine environment with implications on water quality and marine biota.	FPF-1 oil pollution emergency plan (OPEP) variation/ amendment Safety Case variation (scope to be determined at later date)
Chemical use and storage	Resource use	Increase in number of chemicals released to the marine environment with implications on water quality and marine biota.	Chemical permit and risk assessment variation

3.5.10 Chemical requirements

Additional production chemicals for subsea and topsides injection are required for the Vorlich development. It is currently proposed to install a dedicated package to supply some of the required subsea chemicals (methanol, kinetic hydrate inhibitor and wax inhibitor) and new topside H_2S scavenger. Ongoing studies are assessing the opportunity to share chemicals with the existing facilities. The chemical injection package will be installed at the aft of the port laydown area of the FPF-1, see Appendix B – Schematics.

3.5.11 Sand management

Further sand retention tests will be carried out to aide understanding of the completion design requirements. The expected sand production rate and particle size will therefore be further reviewed during detailed engineering.

3.6 Subsea and pipelines

3.6.1 Infrastructure

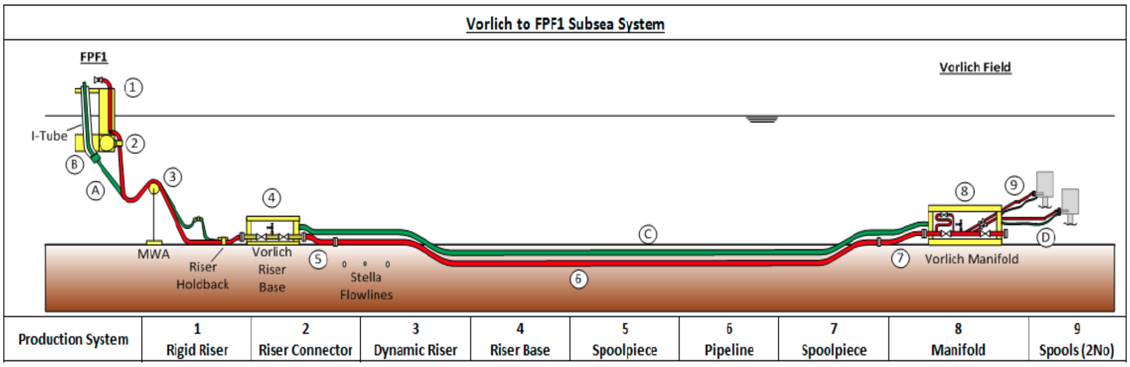
The installation of subsea infrastructure is required to tie the two producer wells back to the FPF-1. Table 3-7 below provides an overview of the subsea infrastructure to be installed.

Table 3-7 Subsea infrastructure

Equipment type	Description
Xmas trees	A subsea xmas tree will be installed onto each well.
Manifold	A piled manifold will be installed at the VDC. This will be designed to be a slab-sided fishing friendly structure with no snaggable protrusions. The anticipated dimensions of the manifold are 16.5m long by 8.5m wide by 7m high, with a weight of 175 tonnes.
Production flowline	9641m long 8"/12" pipe-in-pipe production pipeline will be installed between the VDC manifold and the FPF-1.
Umbilical	9855m long static umbilical will consist of thermoplastic hose and electrical cables and will be laid alongside the production pipeline.
Tie-in spools and jumpers	Each well will be connected to the manifold by 6" super duplex rigid spool pieces and electro-hydraulic control jumpers.
Riser system and Vorlich riser base structure	The installation of the riser system will commence with the installation of the mid-water arch, riser holdback structure and Vorlich riser base from a construction support vessel.

An overview of the Vorlich to FPF-1 subsea systems is presented in Figure 3-7 (for full schematic refer to Appendix B – Schematics).

Figure 3-7 Vorlich to FPF-1 subsea system



3.6.2 Subsea installtion, tie-in and commissioning

3.6.2.1 Vorlich drill centre manifold

A manifold is an arrangement of piping and valves designed to control, distribute and monitor fluid flow from a well. The Vorlich manifold will be a fishing-friendly structure which will be piled to ensure stability in the event of fishing gear interaction.

The manifold structure (located adjacent to the wells) will be connected to each of the wells by 6" super duplex rigid spool pieces and electro-hydraulic control jumpers. The manifold will then be connected back to the FPF-1 by an 8"/12" pipe-in-pipe pipeline.

Four piles will be used to anchor the manifold. The piles are anticipated to be 610mm in diameter and 28m long, with a penetration depth of 21m. Piling is expected to take 1 hour per pile from start to finish.

During piling, a marine mammal observer (MMO) will be stationed on the bridge and daylight soft start piling methodology will be used. (In accordance with the Conservation of Offshore Marine Habitats and Species Regulations 2017.

Refer to Section 5.4 for assessment of underwater sound.

3.6.3 Pipeline design specifications

Table 3-8 presents the flowline and umbilical design specifications.

Table 3-8 Pipeline design specifications

Pipeline	Production flowline	Umbilical
Design pressure (bar)	261	345bar-690bar
Design temperature (°C)	Max 115˚c; Min -30˚	-
Carrier pipe outer diameter (mm)	323.9	180mm
Carrier pipe wall thickness (mm)	12.7	-
Inner pipe internal diameter (mm)	219.1	-
Inner Pipe Wall Thickness (mm)	11.1	-
Length (m)	9641	9746
Line Volume (m^3)	316	-

3.6.3.2 Pipeline installation

A new 8"/12" pipe-in-pipe production pipeline will be installed between the VDC manifold and the FPF-1. The inner production pipe is constructed with solid chromium steel (13% Cr.CRA). The annulus between the inner and carrier pipes will contain insulation, whilst the carbon steel carrier pipe will be coated with an anti-corrosion coating in conjunction with a sacrificial anode system.

Routing of the pipeline, whilst it does not follow a straight line, has been selected to follow existing Stella flowline corridors. It therefore uses existing geotechnical data knowledge; minimises the seabed footprint; and provides a suitable approach to the connection point with the riser facilities at the FPF-1.

The pipeline will be trenched and backfilled along the majority of the route between the manifold and FPF-1. The only section not trenched is at the approach to FPF-1 where the Vorlich pipeline has to cross over the existing Stella infield flowlines and the FPF-1 gas export pipeline. Protection material (rock) will be deposited along this section of the route, 600m in length, following pipelay (Section 3.6.3).

The pipeline will be connected into the Vorlich riser base structure (containing isolation valves) at the FPF-1. On the downstream side of the Vorlich riser base an 8" dynamic riser will be connected. The riser system will comprise a MWA and a holdback structure to maintain the riser configuration between the hang-off location, on the cross pontoon on the FPF-1, down to the seabed. The riser system will also contain a dynamic umbilical which will be routed from the i-tube on the FPF-1, over the MWA and holdback structure to the Vorlich riser base where it connects to the static umbilical to the VDC manifold.

The static umbilical will consist of a thermoplastic hose and electrical cables and will be laid alongside the production pipeline in to the same trench. This will then be backfilled along the majority of the route from the riser base to the VDC manifold, and at the crossing locations on the approach to the FPF-1.

The riser system and Vorlich riser base structure will be installed at the FPF-1. These structures will all be located within the FPF-1 500m safety exclusion zone and therefore will not be designed for fishing interaction.

The riser base is anticipated to be a gravity based structure of dimensions 9m long by 5m wide by 3m high and contain isolation valves for the production riser in addition to a location to connect the static and dynamic riser sections.

The riser system will comprise the MWA, including the Base, and a holdback structure, both of which will be gravity based. The MWA base will be approximately 16m long by 8.5m wide by 3.2m high. The MWA itself will be suspended 34m above seabed and is 13m long by 13m wide by 8.5m high. The holdback structure will 16m long by 8m wide by 2m high. Figure 3-8 presents a representation of the MWA and holdback structure.

Figure 3-8 MWA and holdback structure

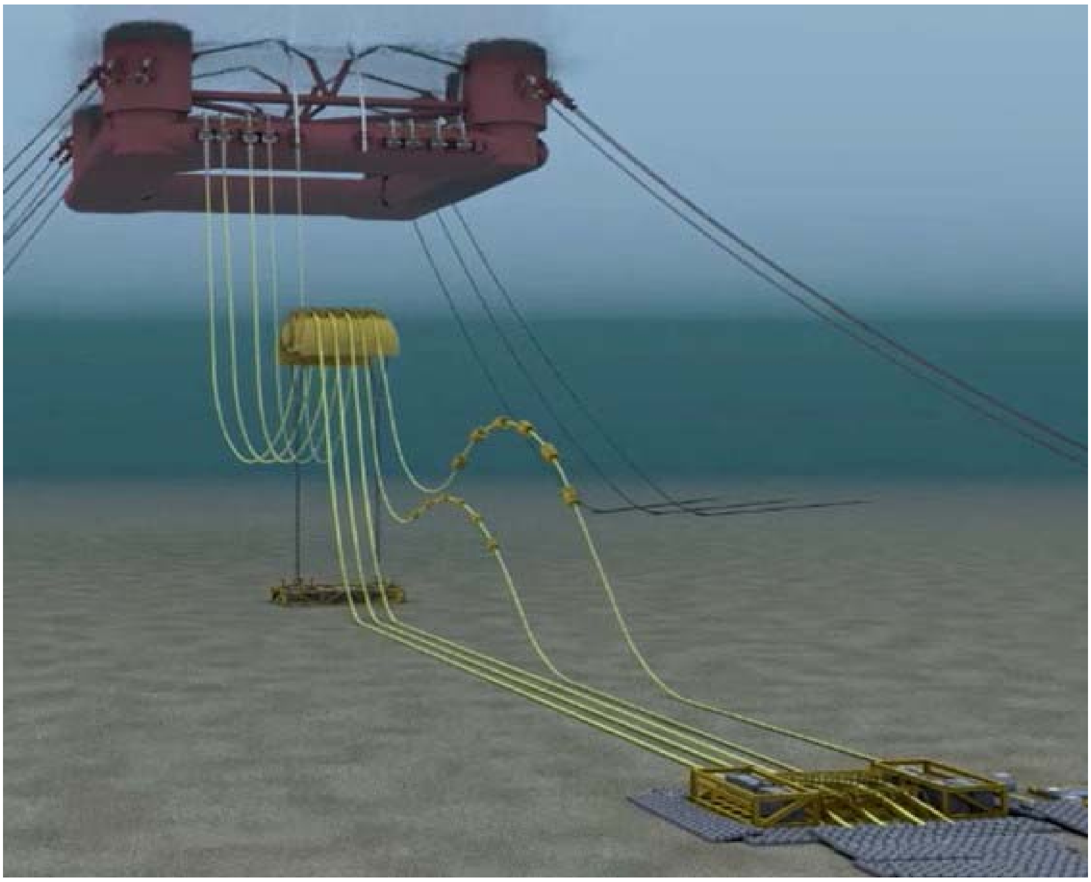
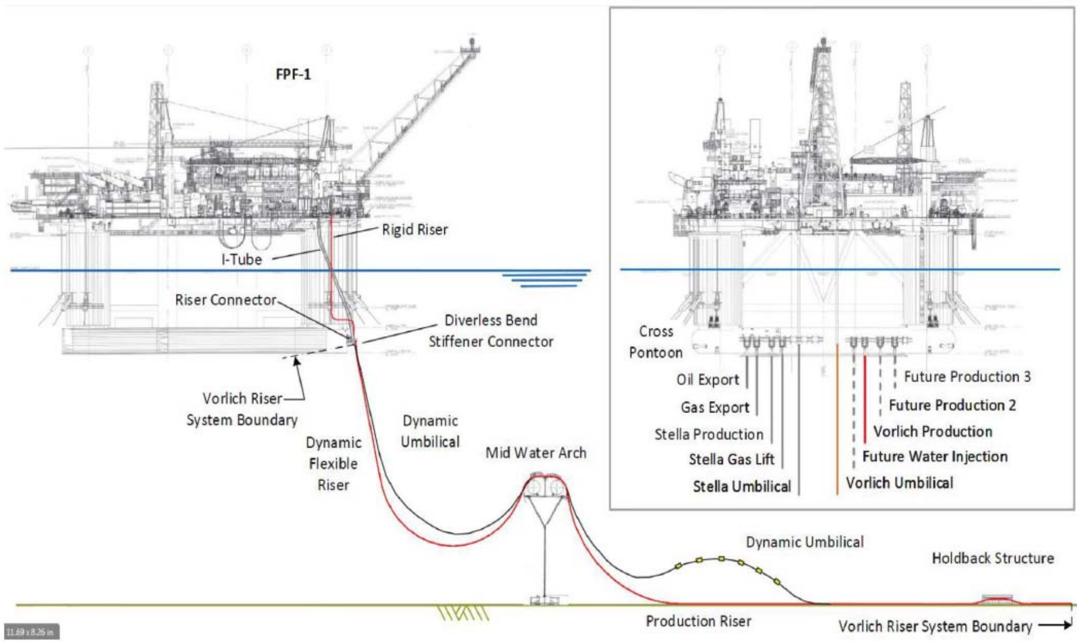


Figure 3-9 presents a schematic view of the MWA and holdback structure (also available in Appendix B – Schematics).

Figure 3-9 MWA and holdback structure – schematic view



Installation and burial of pipelines typically follows the below process:

- Lay on seabed.
- Trench into seabed.
- Flood with chemically inhibited potable water.
- Backfill trench.
- Hydrotest.
- Tie-in pipeline at both ends FPF-1 and VDC.
- Leak-test.
- Dewatering and commissioning.

It is currently anticipated that the pipelines will be laid using the Deep Energy dynamically positioned (DP) pipelay vessel however this is subject to change. The Deep Energy uses thrusters to position itself over the pipeline route. A typical DP vessel has a draft of 6.5m, with the thruster propeller housing extending 2m below this depth. The propellers create disturbance in the water column typically to 5m below the thrusters. Any disturbance below 5m is not discernible from natural currents and wave orbital movements. Therefore, the deepest effects from a DP vessel are anticipated to reach down to approximately 14m from the sea surface.

An initiation anchor (typically a conventional 13½ tonne anchor or similar) will be used at the start of the installation process to help position the pipeline in the target box. However, during the installation process the vessel will not use anchors for positioning.

Prior to the pipelines being laid, a pipeline route obstruction survey will be conducted. This will be conducted by the EDT Jane survey vessel (or similar) and the vessel will remain on-site for the duration of the pipeline installation to provide support to the other pipeline construction vessels. Touch-down of the pipelines will be monitored by a ROV.

Once laid, the pipeline will be trenched using a displacement plough (Figure 3-10). The plough is towed behind a plough vessel, creating an open v-shaped trench into which it guides or directs the pipeline. Spoil from the trench is positioned on either side of the trench in shallow berms. Trenches are likely to be between 2.5m and 6m wide depending on the plough used and the configuration of the plough shares, with spoil heaps up to 3m wide and 2m high on either side. In total a 12m wide strip of seabed will be affected along the pipeline route, although this may vary depending on the equipment used.

Figure 3-10 Displacement plough

Trenching is expected to take up to 3 days to complete. The pipeline will be left in an open trench until the entire length is trenched.

The trench will be terminated 600m from the FPF-1. The target depth for the trench of 1.5m will allow for a 0.9m cover from the top of pipeline to mean seabed level. This was selected based on consideration of the seabed characteristics of the area, confirmed through marine survey (Fugro 2017) and from estimated upheaval buckling criteria. The trench depth selected has been designed to minimise the need for rock dumping.

The pipeline will then be flooded with chemically inhibited potable water (typically containing oxygen scavenger, biocide and dye) to prevent corrosion, following the mechanical trenching operations (see Section 3.6.3.3).

Whilst the trenching vessel is returning to port to offload the trenching plough for the backfill plough the umbilical will be laid into the open trench alongside the production pipe.

A separate backfill plough will then be towed along the route to return the spoil into the trench. After backfill the final seabed profile will be a shallow depression over the pipelines due to the loss of finer sediments from displaced material through winnowing. Small residual berms may be present along the route. A post-lay sidescan sonar survey will be conducted to determine the as-laid position of the pipelines and ensure cover has been achieved.

It is assumed that initial pipelay and trenching operations will affect the same seabed area, totalling approximately 107,772m^2 (8981m x 12m). As the trench will be backfilled with material from the berms, in an area of mobile sediments, it is expected that the seabed footprint will be temporary.

3.6.3.3 Pipeline tie-in and commissioning

In order to prevent corrosion, the pipelines will be flooded with treated potable water following mechanical trenching. Once installed, the pipelines will be hydrotested using potable water to verify system integrity. Typically, inhibited water is pumped into the pipeline (approximately 120% of line volume). It is currently expected that the Deep Arctic Utility support vessel (DSV) will conduct leak testing operations. Pressure of the system is increased until the pressure has been established and a successful hold time and stabilisation period achieved. Test pressure will be held for 24 hours before the pipelines are depressurised, by discharging the extra volume of water to sea, at predetermined rates.

After hydrotesting, divers will install rigid pre-fabricated spools at each end to tie the pipeline into the Vorlich riser base at FPF-1 and to the manifold at the VDC. It is anticipated that it will take sixteen days to complete the subsea tie-in.

Once tied-in the pipelines will be leak-tested, following a similar procedure as hydrotesting, using inhibited potable water. Additional quantities of inhibited seawater pumped into the pipelines to establish leak test pressures will be discharged to sea.

Once fully installed and tested the remaining volumes of inhibited seawater will be flushed out of the pipelines in a process known as dewatering.

Any chemical requirements (typically oxygen scavenger, biocide and dye are used during pipeline commissioning operations) that fall under the Offshore Chemical Regulations 2002 (as amended) will be included on relevant pipeline and/or installation chemical permits where the use and discharge of the exact chemicals, dose and dispersion rates, are fully risk assessed and impact to the marine environment determined.

Commissioning will commence Q2 of 2020 and is expected to take approximately 14 days.

3.6.4 Pipeline Protection

3.6.4.1 Concrete mattresses and grout bags

Concrete mattresses will be used at the VDC to protect the rigid spools and control jumpers between the manifold and the xmas trees and for the pipeline, spools and umbilical between the manifold and the trench transition location.

Concrete mattresses will be installed at the crossing locations prior to pipelay to ensure the minimum separation to the existing pipelines. These mattresses will subsequently be covered by protection material (rock) following pipelay and have therefore not been included within the seabed footprint of the project.

Grout bags will be used at the VDC and the FPF-1 during post installation and pre-commissioning works and for support and protection of the spools, controls jumper bundles and electrical flying leads. The dimensions and expected quantity of concrete mattresses and their corresponding seabed footprint are provided in Table 3-9. It should be noted that these are an estimate and will be subject to change. Final figures will be presented in the relevant permit application.

Table 3-9 Concrete mattresses and grout bags

Location	Size m	Quantity No	Seabed footprint m^2
Concrete mattresses			
Vorlich Drill Centre	6 x 3 x 0.15	75	1350
Pipeline Crossing Locations	6 x 3 x 0.3	6	n/a
FPF1 500m Zone	6 x 3 x 0.15	100	1800

Location	Size m	Quantity No	Seabed footprint m^2
25kg Grout bags			
Vorlich Drill Centre	0.5 x 0.3	400	60[1]
FPF1 500m Zone	0.5 x 0.3	400	60[1]
Total			3270

[1] Grout bags will be used for support and they will be stacked rather than laid individually on the seabed. Therefore, whilst 60m² would be the most conservative basis it's likely that a third of that value is more realistic.

3.6.4.2 Rock placement

Rock will be placed along the 600m approach to the FPF-1 where the new pipeline crosses over the existing Stella infield flowlines and the FPF-1 gas export pipeline. Rock will provide stability and protection along the 600m stretch of pipeline. Rock will be deposited by the Normand Progress fall pipe vessel to ensure accurate positioning. It is expected that 15,000 tonnes will be required for the rock berm at the crossing location, whist an additional 10,000 tonnes may be required for spot rock protection at 30 discrete locations along the pipeline to mitigate against the risk of upheaval buckling (UHB). Currently it is planned that all rock placement will use graded, quarried material (nominal size range 1”-5” diameter)

Table 3-10 Rock placement

Location	Planned rock berm dimensions (m)*	Quantity	Estimated tonnes of rock berm	Total impact area (m^2)
Crossing locations	7m x 600m x 1m high (max)	1	15000	4200
UHB Mitigation	4m x 20m x 0.5m (typical)	30	10000	2400
Total	-	**31**	**25000**	**6600**

3.6.5 Inspection and maintenance

There are no operational pigging requirements for the Vorlich production facilities, however where possible the Vorlich subsea facilities will be designed to be piggable between the production manifold and the top of the riser. Both subsea and topside will require temporary pig launching and receiving facilities to be installed.

3.7 Decommissioning

End of field life is expected to be 2027-2030. Decommissioning will be carried out in compliance with United Kingdom Government legislation and international agreements in force at the end of the field life. Agreement to the Cessation of Production will be sought as a pre-requisite for approval of the Decommissioning Programme. The criteria for Cessation of Production will be discussed with Oil and Gas Authority (OGA) and Department for Business, Energy and Industrial Strategy (BEIS).

The base plan for decommissioning is that the wells will be plugged and abandoned with wellheads and casing removed to below the mud line. The subsea trees will be removed for management onshore. Detailed cost estimates for the decommissioning will be prepared closer to the date and will reflect the circumstances pertaining at the time.

The development plan is based on the assumption that similar requirements to current legislation will be in place. These requirements have been considered in the design of the facilities and during project planning.

It is likely that under the legislation a derogation case will be filed to allow the pipelines to be left in-situ, as long as there are no health, safety and environmental issues associated with this activity. Removal of the pipelines would cause disturbance of the seabed which after 15 years should have returned to pre-installation baseline conditions. Under current legislation decommissioning requires an EIA to be conducted prior to activities commencing. The EIA will assess the benefits and costs of different decommissioning scenarios i.e., removal versus remaining in-situ.

The impacts of decommissioning activities on the environment have not been assessed under the scope of this document as they will be the subject of a separate EIA

4. THE BASELINE AND ENVIRONMENTAL DESCRIPTION

This Chapter describes the existing baseline environment for the development area and export pipeline route. For the purposes of the EIA the environment has been divided and considered as follows:

- Physical: metocean, air quality, water quality and seabed conditions;
- Protected and sensitive sites;
- Biological: benthos, plankton, fish and shellfish, seabirds and marine mammals; and
- Human: commercial fisheries, shipping and navigation, and other marine users.

A good understanding of the baseline for these attributes has been achieved through two activities:

- Reviewing marine survey data for the development area and surrounds; and
- Collating and reviewing secondary data sources (e.g. existing studies, literature and reports) referenced throughout the text.

4.1 Seabed surveys

Three seabed surveys have been undertaken within or near the development area. The data acquired provides an overview of the development area in terms of geological and sediment features and bathymetry. The surveys also detail the habitats and sensitive/protected features found in Blocks 30/1 and 30/6 (within which the development area is located) and the surrounding area.

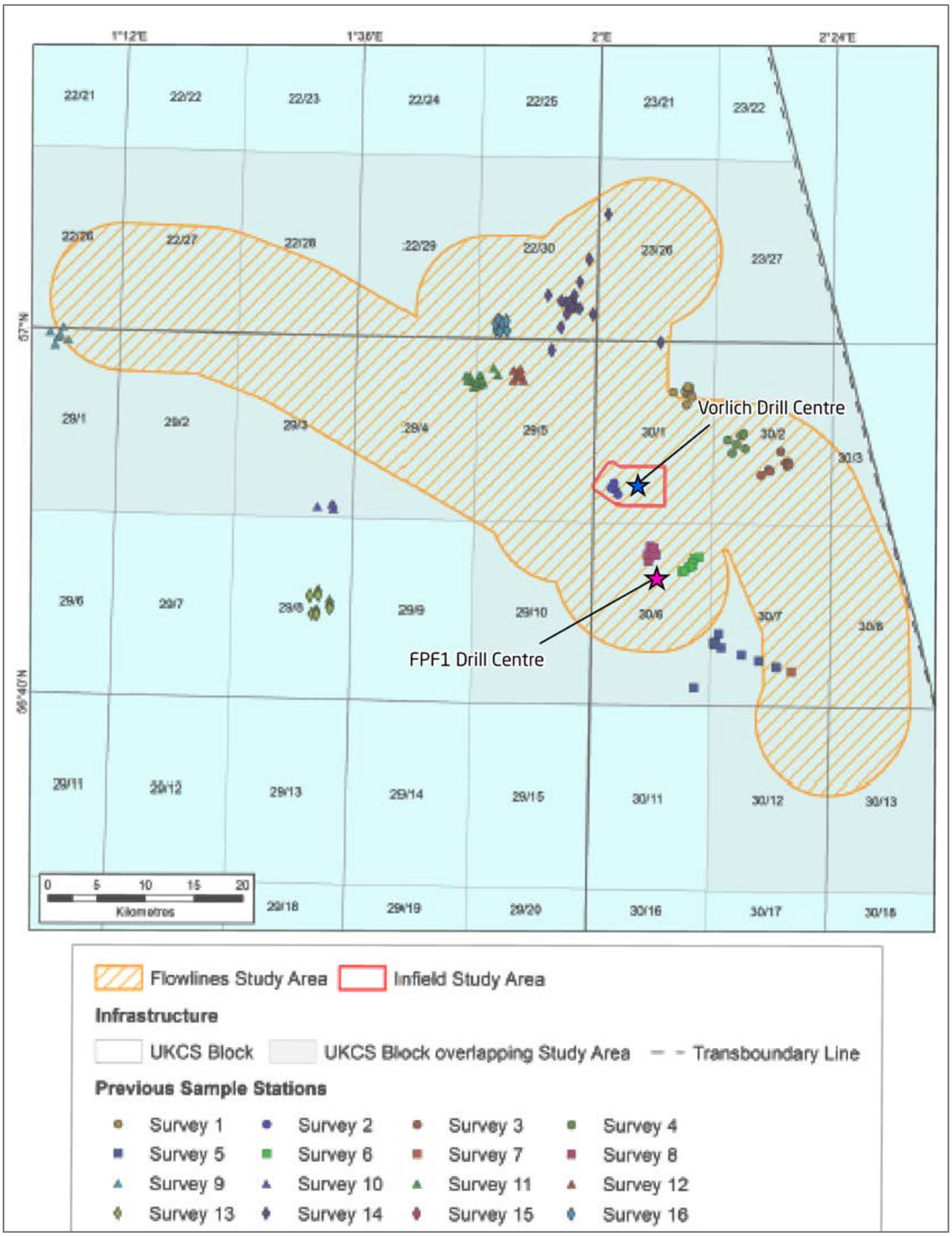
The scopes and methods used are discussed below.

4.1.1 Fugro 2017: Habitat Assessment – Vorlich Development – UKCS Blocks 30/1c and 30/6a

4.1.1.1 Scope

A desk study was completed by Fugro in 2016 for the development area. The objective was to review historic survey data, identify potential environmental constraints / sensitivities and identify any gaps that required acquisition of new survey data. The extent of the surveys that the desk top study reviewed are illustrated in Figure 4-1.

Figure 4-1 Seabed surveys described in the Fugro (2016) desk study



Following the desk-top study, BP commissioned Fugro to perform a route survey at the Vorlich field, located in Blocks 30/1c and 30/6a in 2017. The Vorlich route survey established water depth; seabed topography; shallow geological features/conditions; and manmade features that could affect the design and installation of a single production flowline and separate umbilical between the VDC and the FPF-1. The survey report is referenced throughout this ES as Fugro (2017). This report will be followed by an Environmental Baseline Survey (EBS) Report, available at the end of April 2018, after submission of this ES. The findings of the EBS will be incorporated into permit applications for drilling and pipeline installation activities.

4.1.1.2 Methods

The 2017 shallow geophysical route survey was designed to cover a 600m wide route corridor and comprised of five route lines and eight cross lines. The route lines were arranged with a centre line, two wing lines offset 100m and 200m east and two wing lines offset 100m and 200m west. Cross lines were arranged to tie interpretation together and assist in data coverage across 500m zones.

Environmental sampling and analysis were also undertaken within the survey area. The objectives of which were to describe the habitats and species recorded from the video and stills image analysis. Attention was paid to identifying EC Habitats Directive Annex I listed habitats, OSPAR (Oslo-Paris Convention for the Protection of the Marine Environment of the North-East Atlantic) threatened or declining species or habitats, priority species under the UK Biodiversity Action Plan (BAP) and Nature Conservation Marine Protected Area (NCMPA) priority marine features.

A total of 20 drop-down video locations, and 2 video transects were completed. The drop-down videos were positioned to collect video and stills of the grab sampling locations. Of these, 13 were positioned at approximately 500m intervals along the proposed pipeline route. A total of 10 grab sampling stations were preselected by BP following the 2016 desk-based study to ensure adequate coverage of the development area and to ensure that survey effort recorded any protected features of the nearby Fulmar MCZ and East of Gannet and Montrose Fields NCMPA. A total of four grab samples were acquired from each station (apart from station 5 were only two were acquired); physiochemical and infaunal analyse is be conducted on these samples; the results of which will be available at the end of April 2018.

4.1.2 Calesurvey 2014: FPF-1 to SAL Base Survey - Habitat Assessment Survey

4.1.2.1 Scope

During November 2013, Calesurvey carried out a geophysical site survey, over the proposed single anchor loading (SAL) base in the Stella field (UKCS Block 30/6). An additional environmental survey along the proposed pipeline route between FPF-1 and the proposed SAL base was also carried out. This is adjacent to Block 30/1 where the VDC is located.

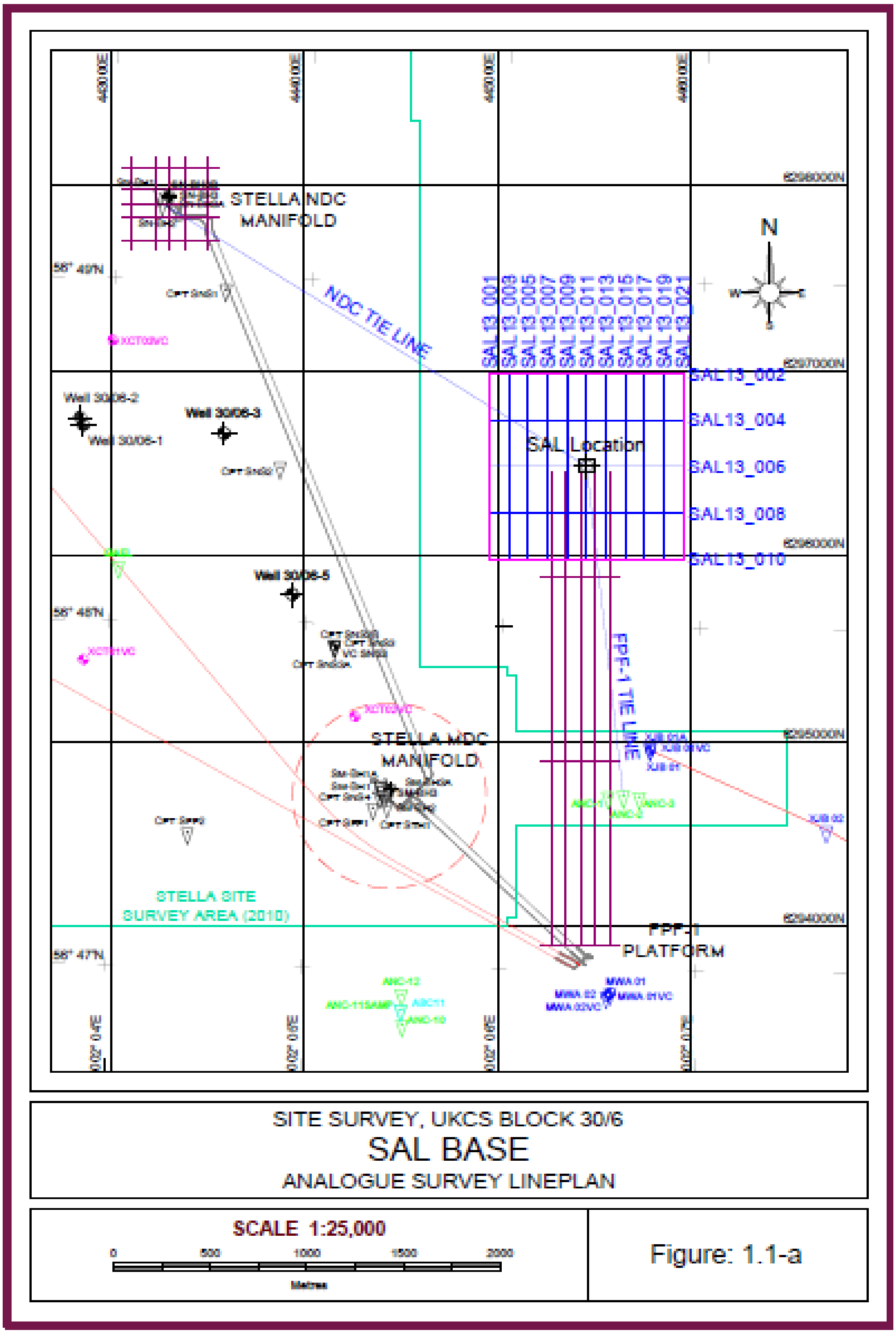
The objective of the SAL site survey was to accurately determine water depths and to locate and identify any seabed features and sub-seabed features. The survey is referenced throughout this ES as Calesurvey (2014).

4.1.2.2 Methods

A geophysical survey, using a hull mounted pinger, mini-airgun, a single beam and multibeam echosounder and dual-frequency side scan sonar, was conducted over a 1km by 1km area centred on the SAL base location. The survey line plan consisted of 11 main lines running north-south at 100m spacing and 5 cross lines running east-west at 250m spacing. Two tie lines were completed from the SAL site centre to two previously drilled boreholes; SN-BH2 at the Stella northern drill centre and ANC-2.

Following the acquisition of geophysical data, three environmental sampling locations were selected; equally spaced along the proposed pipeline route, because of the lack of visible features of interest observed (Figure 4-2). The three sites were ground-truthed using a seabed camera system acquiring 98 high quality still images and approximately 63 minutes of continuous video. One of the stations is within the SAL survey area, 390m south of the SAL site centre.

Figure 4-2 Environmental stations surveyed during Calesurvey (2014)



4.1.3 Ithaca-Energy (UK) Ltd 2011: Stella and Harrier Field Development Block 30/06a - Environmental Statement

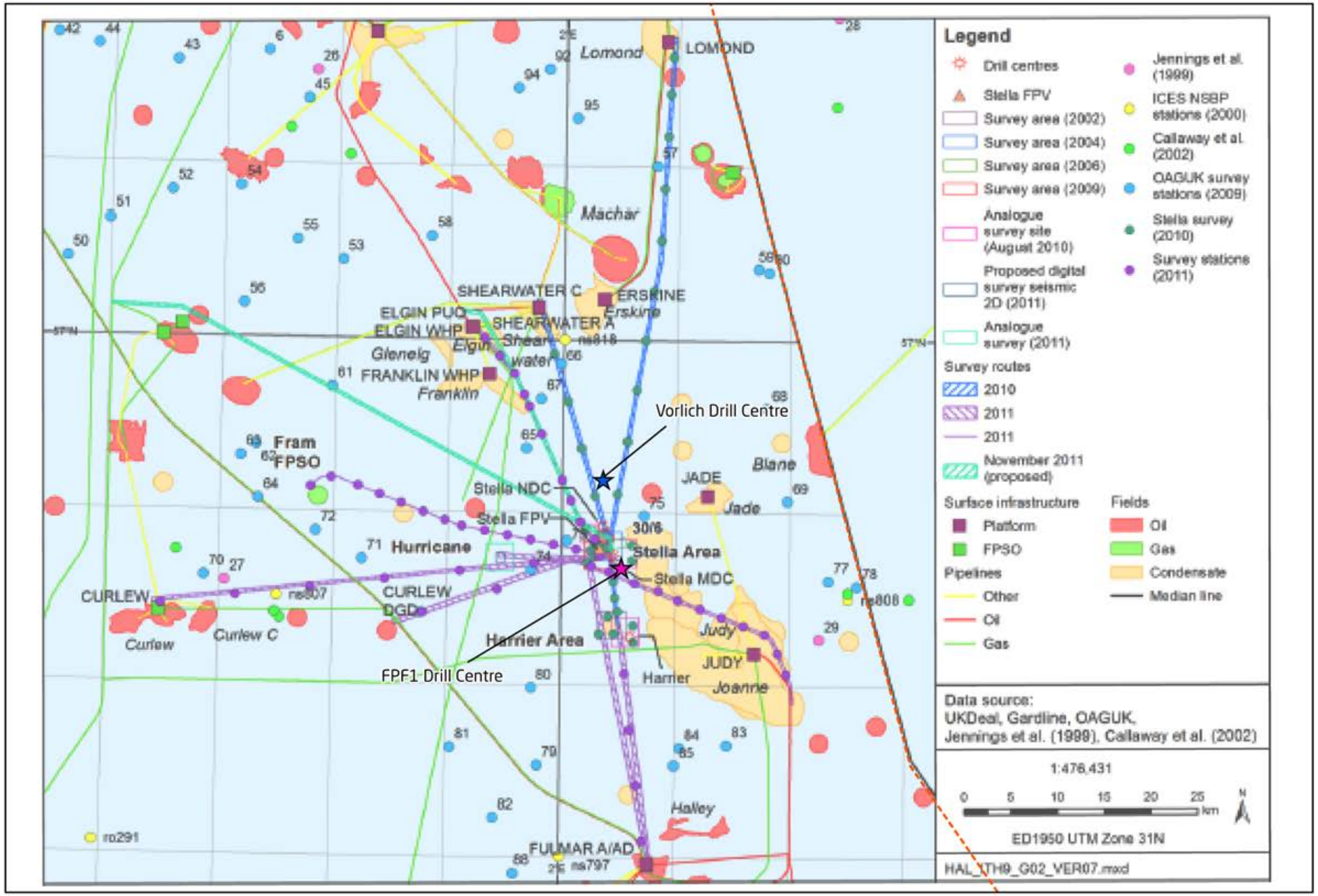
4.1.3.1 Scope

Prior to the development of the Stella and Harrier fields, seabed mapping and habitat surveys of areas potentially affected by the proposed development were undertaken. The FPF-1 is located within the Stella field at the southern end of the Vorlich development (see Figure 1-1). The objectives of the surveys were to establish whether there were any seabed sensitivities along the proposed pipeline route which might influence the development process or present technical challenges to installing a pipeline. These surveys are discussed in detail in the Stella and Harrier Field Development ES, which is referenced as Ithaca (2011) throughout this ES.

4.1.3.1 Method

The surveys included multibeam echosounder and side scan sonar, video/photographic analysis and grab sampling. Photographic analysis and grab sampling were used to confirm the interpretations of the side scan sonar. A number of surveys were used to inform the Stella and Harrier field development ES, these are illustrated in Figure 4-3. These surveys provided a good understanding of seabed and sediment characteristics.

Figure 4-3 Seabed surveys in the Stella and Harrier fields



4.2 Physical environment

4.2.1 Metocean

4.2.1.1 Climate

The development area is situated in the CNS in Regional Sea 1, according to the UK Offshore Energy Strategic Environmental Assessment (OESEA) Reports (DECC 2016). The air temperature in the region is usually between 0-19°C but can be influenced by easterly winds which generate extreme cold in winter and warm conditions in summer (DECC 2016).

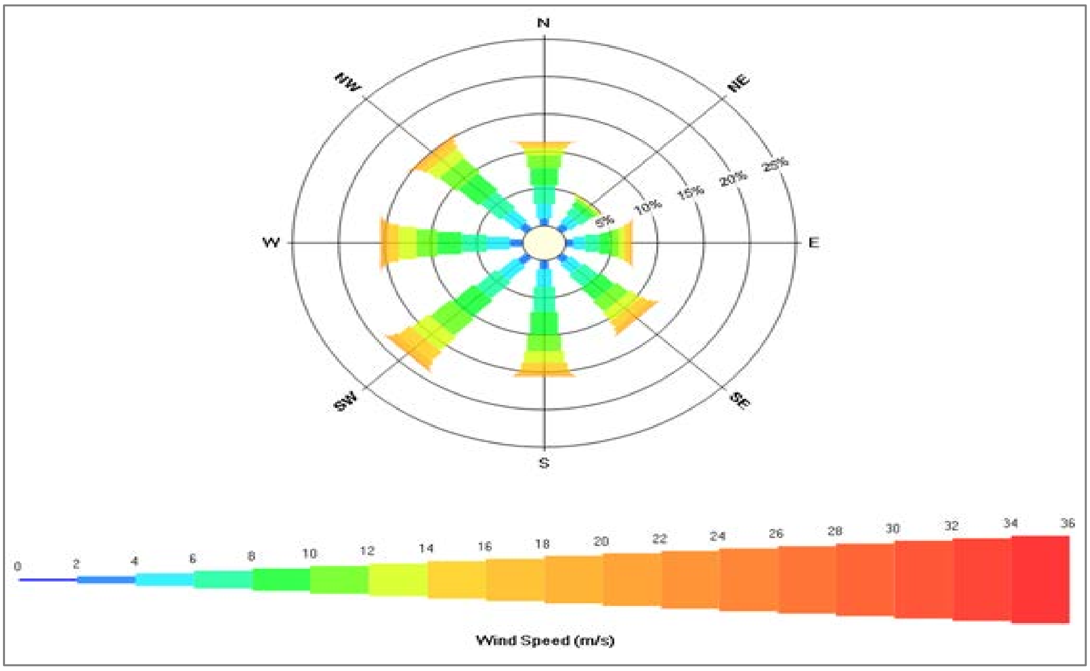
Rainfall in Regional Sea 1 tends to increase with distance offshore, increasing significantly in the east, and follows a seasonal trend similar to that observed onshore. April to June tend to be the driest months, with October to January being wetter. Thunderstorms are infrequent, and snow showers vary from 5-7 days per year in the south of the region, to 10-12 days in the development area region, and 30-40 in the north (DECC 2016).

Fog can reduce visibility to less than 1km 3-4% of the time and is associated with winds between south-east and south-west. Radiation fog can form for 3-6 days per month between October and April and tends to occur during the night; it is dispersed by the sun on all but the coldest days (DECC 2016).

4.2.1.2 Winds

Prevailing winds in Regional Sea 1 are from the south-west and north-north-east. Wind strengths in winter typically range between Force 4-6 (Beaufort scale), with higher winds of Force 8-12 being much less frequent (DECC 2016). Winds of Force 5 and greater are recorded 60-65% of the time in winter and 22-27% of the time in summer. In April and July, winds in the open, central to northern North Sea, are highly variable and there is a greater incidence of north-westerly winds (DECC 2009). This is evidenced by wind data from the nearby Marnock field (approximately 53km to the north-west of Vorlich) which shows a tendency for stronger wind speeds from the south-west and north-west. Given that Marnock is situated in the CNS 21km north of Vorlich, this wind rose data is representative of the likely conditions within the development area.

Figure 4-4 Mean wind speed/direction distribution and rose at Marnock



Source: BP (2009)

4.2.1.3 Water masses

The water of the North Sea consists of a varying mixture of North Atlantic water (salinity >35) and freshwater run-off. Temperature characteristics of different areas are strongly influenced by heat exchange with the atmosphere and source water temperature (DECC 2016).

Within the complex North Sea habitat, there are three regional circulations for the northern, central and southern regions. These differences are determined by density differences, wind strength and direction, tides, and the shape and depth of the sea bed. The ocean temperature differs through depth, with the colder bottom temperatures being driven by preceding cold winters of the North Sea and are kept isolated by the persistent flows of warmer waters from the Atlantic Ocean. In the winter there is an inversion of the south-to-north temperature gradient, with the northern boundary of the North Sea warmer (7°C) than the SNS (5°C). In summer this is reversed, with the SNS warmer (14°C) than the north (11°C). The NNS therefore has a smaller annual temperature range (4°C) compared to the south (9°C) (Turrell and Bannister 2003). This results in the CNS maintaining a relatively constant sea bottom temperature throughout the year, ranging between 6°C in winter and 7°C in summer. Sea surface temperatures around the development area vary seasonally between 6°C and 8.5°C in winter and between 14.5°C and 15°C in summer (Fugro 2016).

4.2.1.4 Currents

The waters of the CNS, in general, form a relatively dynamic environment because of strong tidal currents and frequent storms during the winter months. These can result in current speeds in the range of 0.34-0.43ms^{-1} (BP 1996). However, residual currents are relatively slow. The residual current in the region of the development area is generally in a northerly direction, at a speed of around 0.33 knots (0.16ms^{-1}) (Fugro 2016).

The circulation of the near surface water mass in the CNS is predominantly driven by the inflow of Atlantic surface water at the north-western boundary of the North Sea. Short-medium term weather conditions strongly influence circulation resulting in substantial variability between seasons (UKMMAS 2010). It can be assumed that similar current profiles will be present within the development area as are found at Machar, due to both areas being of similar depths and close proximity; Machar is located approximately 21km north of Vorlich. Modelled mean residual currents (i.e. non-tidal currents) near Machar are 0.05ms^{-1} (UKMMAS 2010).

4.2.1.5 Waves

Waves are directly driven by winds, modified by currents and shallow sea-floor topography. In UK waters, wave climate is strongly seasonal; mean wave heights peak around January, with a high risk of high monthly-mean wave heights and extreme wave heights from October to March (UKMMAS 2010).

The height of offshore waves depends on the strength of the wind, its duration and the 'fetch' (i.e., the distance) over which the wind has acted on the ocean surface. High waves are a risk to platforms and pipelines and therefore estimates of likely extreme waves are essential for the design of offshore structures (UKMMAS 2010).

The CNS is subject to moderate to strong breezes, which give rise to a generally moderate wave regime with significant wave heights over 2m. Annual mean wave height at the development are is recorded to be 2.17m (The Scottish Government 2017).

4.2.2 Air quality

This section is concerned with atmospheric concentrations of gases which are potentially harmful to health; primarily carbon monoxide (CO), nitrogen oxides (NO_x) and sulphur dioxide (SO_2). Particulate material (PM) is not considered as the majority of PM offshore is likely to be of marine origin (Fuzzi *et al.* 2015). Concerns over air quality are primarily related to emissions from road transport and land-based industry as these are the main sources of combustion products onshore (Defra 2011). Offshore air quality is not routinely monitored; however, an understanding of the existing air quality in the development area is useful when assessing any impact upon air quality from the proposed operations.

In general, UK mainland air quality has been improving since 1990. Emissions of NO_x and SO_2 have decreased by 46% and 82% respectively due to reduced emissions from road transport and power stations (Dore *et al.* 2008). Levels of primary atmospheric pollutants tend to be highest close to their sources i.e. in urban and industrial areas. The High Muffles monitoring station (on the North York Moors and designated as a Rural Background site) is likely to provide a reasonable indication of the current levels of airborne contaminants to be found over the adjacent North Sea. Data for this site indicates that contamination levels are low (Defra 2015). It would be expected that the development area, which is 241km from the nearest coastline, is unlikely to suffer from air quality issues.

4.2.3 Water quality

Hazardous substances enter the marine environment due to natural processes and as a result of anthropogenic activity (UKMMAS 2010). Water quality in the UKCS generally reflects the sources and modes of transport of potential contaminants to the marine environment. Contaminants that are volatile and pre-dominantly sourced through combustion processes (e.g. mercury and its compounds, volatile organic compounds, polycyclic aromatic hydrocarbons), and therefore have an atmospheric transport route, tend to be widely distributed.

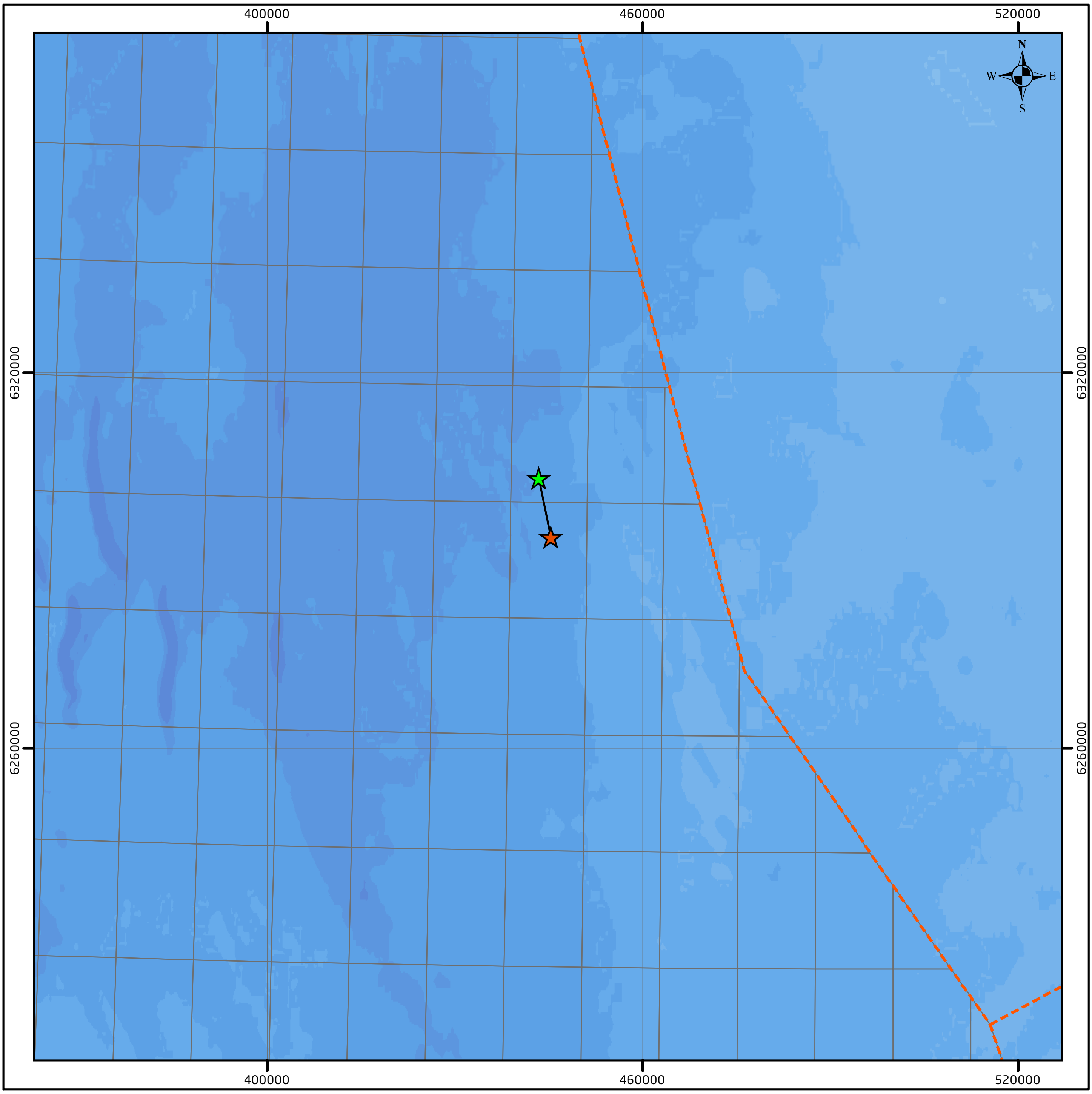
4.2.4 Seabed conditions

4.2.4.1 Bathymetry and seabed features

The water depth at the development area ranges from approximately 75m in the south-east to over 90m in the north-west (Fugro 2016). Bathymetric descriptions from numerous surveys (reviewed in Fugro 2016) described the development area and surrounds as generally flat with a seabed gradient of less than 1° towards the north-west (Figure 4-5).

Some regions of the CNS have areas of soft mud characterised by small depressions or pockmarks (DECC 2009). These are shallow seabed depressions typically several tens of metres across and a few metres deep, and are formed in soft, fine-grained sediments when fluids (gas or water) escape from the sediment into the water column. There is no evidence of pockmarks within the development area (Fugro 2016).

Fugro (2016) describes the seabed around the development area as comprising of fine sands and silts. Accumulations of clay outcrops, boulders/debris, shell fragments and occasional patches of gravel were also identified in the geophysical data available for the area (Fugro 2016). The 2017 survey characterised the seabed as relatively featureless with sediments largely composed of fine sediment. Data from the Marconi well site survey (which lies within the development area) shows numerous depressions, boulders and debris towards the west of the development area. Analysis of the depressions in conjunction with seismic and geophysical data collected during the survey suggests that these depressions are unlikely to be pockmarks. Many of the depressions within the development area contain boulders or debris. Large boulders within depressions were also identified in the other surveys within the development area (Fugro 2016).

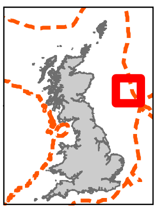


Legend

- Vorlich Drill Centre
- FPF-1
- Vorlich Pipeline
- Median Line
- Licence Block

Bathymetry (mOD)

- -200 - -100
- -100 - -90
- -90 - -80
- -80 - -70
- -70 - -60
- -60 - -50



NOTE: Not to be used for Navigation

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Figure 4-5: Bathymetry Overview

Date	Wednesday, March 7, 2018 09:38:27
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	CDA, OSOD, ESRI, EMODNET
File Reference	J:\P2206\Mxd\ Bathymetry.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Kerri Gardiner

km
0 8 16 24 32 40

4.2.4.2 Seabed geology

Seabed geology within the development area consists of a thin veneer (<0.2m thick) of Holocene fine silty sand. This veneer is underlain by sediments belonging to the Forth Formation, Coal Pit Formation and Fisher Formation. Generally, across the pipeline route corridor the Coal Pit Formation is the main underlying geology; the Forth Formation is absent and only forms a minor unit in localised areas comprising of soft silty clays and very fine shelly sand. The Coal Pit Formation is interpreted, from the marine survey data, to comprise sand, silty clay and interlaminated clay with fine silty sand. Where the Fisher Formation is present it is interpreted to comprise very stiff, overconsolidated clay, silty and shelly sand (Fugro 2017).

4.2.4.3 Sediment features and quality

The seabed sediments of the CNS typically consist of large areas of sand and slightly gravelly sand (DECC 2009). The fine-grained sediments of the greater CNS are primarily distributed within the Fladen and Witch grounds. Surveys within the development area describe sediments as fine sand with patches of clay and gravel. This is supported by the Fugro (2017) habitat assessment, which characterised the seabed within the development area as "relatively featureless, with the seabed sediments composed of fine sediments". In addition, survey results from the development area and surrounds acquired samples which were thought to contain the presence of drill cuttings and muds (Fugro 2016).

The Oil and Gas UK (OGUK) CNS regional survey (2009), which included the Stella area, showed mean total hydrocarbon concentrations (THC) levels which were indicative of uncontaminated sediments (Ithaca 2011) near Vorlich. Metal and polycyclic aromatic hydrocarbon (PAH) concentrations were both similar to or below background concentrations levels for the Northeast Atlantic (OSPAR 2005). Analyses of samples taken during the various site surveys of Stella and Harrier typically showed contaminant concentrations at background levels (Ithaca 2011).

4.3 Protected and sensitive sites

There are different types of designation for offshore protected and sensitive sites in UK waters. A geographical information system was used to identify sites within 40km of the development area (potentially sensitive habitats outside of this 40km have however been included in this assessment as a hydrocarbon release from a well blow-out has the potential to impact these sites). The sites identified are discussed below and illustrated on Figure 4-6.

4.3.1 Designated sites within 40km

4.3.1.1 The East of Gannet and Montrose Fields Nature Conservation Marine Protected Area (NCMPA)

The East of Gannet and Montrose Fields NCMPA is located 29km to the west of the development area and covers an area of 1,839km^2. The NCMPA lies within a relatively shallow sediment plain comprised mainly of sand and gravel habitats that support a range of benthic species.

The NCMPA is designated for the protection of ocean quahog (*Arctica islandica*) aggregations (a Priority Marine feature, PMF) which are listed as Threatened and/or Declining across the North-east Atlantic by the Oslo and Paris (OSPAR) Commission. The NCMPA also protects the full extent of an area of offshore deep-sea mud (PMF). By protecting the full extent of the deep-sea mud in this area, the NCMPA protects a coherent, rather than fragmented, example of this habitat. This is one of the few examples of Atlantic-influenced offshore deep-sea mud habitats on the continental shelf in the region. Furthermore, East of Gannet and Montrose Fields is the only NCMPA designated in this region for the protection of offshore deep-sea muds. The deep-sea muds occur in a 2-7km wide band from the south east to the north west of the NCMPA, in approximately 100m water depth (JNCC 2017a).

The conservation objective for the protected features of the East of Gannet and Montrose Fields NCMPA is to conserve in a favourable condition (JNCC 2017a; Marine Scotland 2014).

4.3.1.2 Fulmar Marine Conservation Zone (MCZ)

The Fulmar MCZ is located 29km to the south of the development area and covers an area of 2,437km^2.

The seabed in the MCZ is predominantly subtidal mud, with small patches of other sediments. Burrowing tube anemones (*Cerianthus lloydii*), brittlestars (including *Amphiura filiformis* and *Ophiura albida*) and sea potatoes (*Echinocardium cordatum*) are found living on the sediments at Fulmar MCZ. Sea pens such as the slender sea pen (*Virgularia mirabilis*) are also present. Fulmar MCZ is home to a wide variety of worms that live within the sediment, which are an important food source for many other animals, including commercial fish species (JNCC 2017b).

The designated features of this MCZ are subtidal mud, subtidal sand (PMF) and subtidal mixed sediment, and ocean quahog (*Arctica islandica*) (PMF) (JNCC 2017b). The conservation objectives for the Fulmar MCZ are that the protected features remain in favourable condition and “so far as not already in favourable condition, be brought into such condition, and remain in such condition” (JNCC 2017b).

4.3.2 EC Habitats Directive - Annex I habitats

<u>Protected submarine structures made by leaking gases</u>

Two Special Areas of Conservation (SAC), Scanner Pockmark (approximately 170km north) and Braemar Pockmarks (approximately 235km north), are designated within the North Sea to protect pockmarks containing carbonate blocks and pavement slabs formed by leaking gas as these can be classed as the Annex I feature ‘submarine structures made by leaking gases’. Other gas seeps are known to occur in the North Sea, although additional extensive submarine structures have yet to be found (Fugro 2017).

The Annex I habitat ‘submarine structures made by leaking gases’ comprises rocks, pavements and pillars made of carbonate cement. Such cement is mostly made by microbial oxidation of methane and is commonly known as MDAC (methane-derived authigenic carbonate). MDAC forms within the sediment at the sulphate-methane transition zone, within a few metres of the seabed (Judd 2005). MDAC concretions in the form of crusts or slabs may then be brought up to the surface by natural movements of surficial sediments. These exposed lumps can influence the local benthos, by providing hard substratum and shelter in an otherwise soft sediment environment. Within UK waters this habitat is predominantly associated with pockmarks in the northern and central North Sea, as well as part of the Irish Sea (Fugro 2017).

The closest Annex I ‘potential submarine structure with pockmarks’ is located approximately 70km to the west of the development area. No potential submarine structures with pockmarks were observed during the 2017 survey or any other surveys reviewed in the Fugro (2016) desk top study.

<u>Potential reef</u>

The Annex I habitat ‘reefs’ occur where rocky areas or concretions made by marine animals arise from the surrounding seafloor. There are three main types of Annex I reef; bedrock, stony and biogenic. Bedrock and stony reefs are a type of rocky reef which occur where the bedrock or existing boulders and cobbles create a habitat which is then colonised by marine animals and plants. These reefs can be variable in terms of their structure and the communities they support. They can support species such as corals, sponges and sea squirts, as well as provide shelter to fish and crustaceans (JNCC 2014). Biogenic reefs are created by animals themselves. In the UK these constitute reefs made by cold water corals, reef-building worms such as the honeycomb worm *Sabellaria alveolata*, the Ross worm *Sabellaria spinulosa* and the serpulid worm *Serpula vermicularis* and mussels such as the edible mussel

Mytilus edulis and the horse mussel *Modiolus modiolus.* In offshore waters, cold-water coral reefs, *S.spinulosa* reefs and *M. modiolus* reefs are used to identify potential SACs (JNCC 2014).

The closest bedrock reef is located approximately 99km to the west of the development area, whilst the closest biogenic reef is 275km to the southwest.

Protected sandbanks which are slightly covered by seawater all of the time

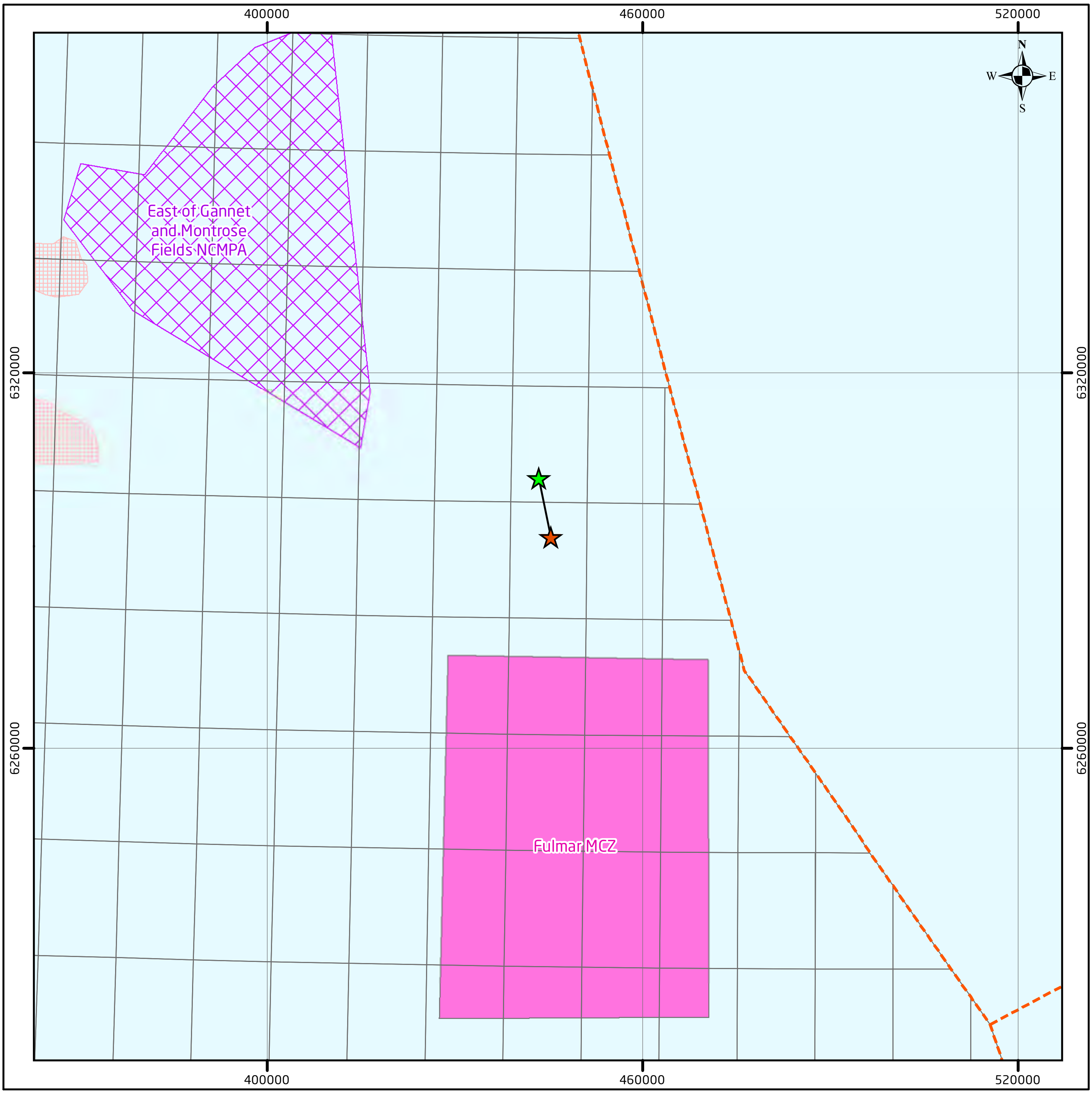
The Annex I habitat 'sandbanks slightly covered by seawater all the time' occurs where areas of sand form distinct elevated topographic features which are predominantly surrounded by deeper water and where the top of the sandbank is in less than 20m water depth. However, the sides of these sandbanks, can extend into deeper water up to 60m whilst still being considered the feature.

The biological communities typical of sandbanks can vary greatly depending on sediment type and depth, as well as fine-scale physical, chemical and biological processes. Communities found on sandbank crests are predominantly those typical of mobile sediment environments and tend to have low diversity. Fauna such as polychaete and amphipod thrive in this environment as they can rapidly re-bury themselves. Animals like hermit crabs, flatfish and starfish also live on top of the sandbank. Troughs or areas between banks generally contain more stable gravelly sediments and support diverse infaunal and epifaunal communities. Here sediment movement is reduced and therefore the areas support an abundance of attached bryozoans, hydroids and sea anemones. In the Southern North Sea, there have been frequent observations of biogenic reefs created by the Ross worm *Sabellaria spinulosa* in association within sandbanks (JNCC 2017c).

The closest Annex I sandbank is the Dogger Bank which is classified as an SAC and is 161km to the south of the development area.

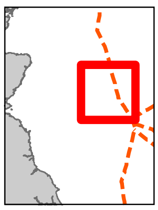
4.3.3 Priority Marine Features (PMFs)

PMFs are habitats and species which are of conservation importance. It is envisaged that their classification will help to deliver the Scottish Governments Marine Nature Conservation Strategy (Scottish Natural Heritage 2014). PMFs include seabed habitats, low or limited mobility species, crustacean, bony fish, elasmobranchs (sharks, skates and rays), cetaceans (whales, dolphins and porpoises), seals, and otter. Habitats or species included on the list (adopted 24 July 2014) are identified throughout this baseline.



Legend

- Vorlich Drill Centre
- FPF-1
- Vorlich Pipeline
- Median Line
- Licence Block
- MCZ
- NCMPA
- Potential Submarine Structure within Pockmark



NOTE: Not to be used for Navigation

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Figure 4-6: Marine Protected Sites and Sensitive Sites

Date	Wednesday, March 7, 2018 09:53:29
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	CDA, OSOD, JNCC, ESRI, TCE
File Reference	J:\P2206\Mxd\ Protected_Sites.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Kerri Gardiner

km: 0 8 16 24 32 40

4.4 Biological environment

4.4.1 Benthos

For the purpose of this assessment, benthic communities comprise those species (excluding commercially exploitable shellfish) that live on (epifauna) or in (infauna) sediments.

4.4.1.1 Infauna

Ithaca (2011) details a seabed survey conducted in 2006 around the Stella appraisal well 30/06-8 in Block 30/6. This survey found the top 10 species in terms numerical abundance to be *Galathowenia oculate* (polychaete), Echinoidea juveniles (sea urchin), *Paramphinome jeffreysii* (polychaete), Ophiuroidea juveniles (brittle star), *Thyasira pygmaea* (bivalve), Ampharetidae juveniles (polychaete), *Eclysippe* (Pterolysippe) cf. *vanelli* (polychaete), *Spiophanes kroyeri* (polychaete), *Pholoe inornata* (polychaete) and *Minuspio cirrifera* (polychaete). Analysis of benthic samples collected in 2010 for the Stella and Harrier field development ES indicated a similar faunal assemblage to that found during previous surveys taken in 2006 (Ithaca 2011). Juvenile animals constituted between 30 and 60% of the total fauna retained on the smallest sieve used to screen the benthic samples. The most abundant juveniles were Echinoidea (sea urchins), Ophiuroidea (brittle stars) and Pectinariidae (polychaete) (Ithaca 2011).

The Fugro 2017 survey assigned the biotope complex “Circalittoral muddy sand” (A5.26) to the seabed within the development area, in accordance with EUNIS biotope classification (EUNIS 2012). The corresponding JNCC classification is ‘circalittoral muddy sand’ (SS.SSa.CMuSa). Soft sediment communities are typically defined by infaunal taxa, in particular, a wide variety of polychaetes and bivalves. The EUNIS biotope classification ‘Circalittoral muddy sand’ (A5.26) is supported by the confirmation of muddy sand from sediment particle size analysis data from previous surveys (Fugro 2017).

4.4.1.2 Epifauna

Photographic sampling taken during the various site and pipeline route surveys for the Stella and Harrier development indicate a muddy sand seabed with a relatively sparse epifauna but also showed evidence of bioturbation by deep burrowing animals in the form of pit, mounds and Norway lobster (*Nephrops norvegicus*) burrows (Ithaca 2011). Areas showing greater texture in side scan sonar images were found to be accumulations of dead bivalve shells (mainly *Arctica islandica* and *Acanthocardia* sp.) although occasional pebbles, cobbles and small boulders were also present.

The dominant epifauna taxa present during the 2017 habitat surveys of the development area included the sea pens (*Pennatula phosphorea* and *Virgularia mirabilis*). Other taxa observed included hermit crabs (*Pagurus bernhardus*), swimming crabs (*Liocarcinus depurator*), whelk (Buccinidae), urchins (Spatangoida), Norway lobster (*N.norvegicus*) and starfish (Asteroidea) (Fugro 2017).

The identification of Norway lobster burrows and *A. islandica* shells in the area during 2010 surveys and the sea pens observed during the 2017 development area survey supports the potential for OSPAR listed threatened and/or declining habitats and species to occur within the development area, as described in Section 4.4.1.3 below (Fugro 2017).

An image of the epifauna observed during the 2017 Fugro survey is shown in Figure 4-7 below.

Figure 4-7 Epifauna and sediments observed in the development area

Soft sediments characterised by the sea pens *Virgularia mirabilis* and *Pennatula phosphorea.*

The epifaunal community associated with the soft sediments included: Norway lobster (*N.norvegicus*), swimming crab (*Liocarcinus depurator*) and hermit crabs (*Pagurus bernhardus*).

Encrusting, tube dwelling polychaetes (Serpulidae) and hydroid/bryozoan meadow were observed on shell material.

Fugro (2017)

4.4.1.3 Sensitive species and habitats

Potentially sensitive habitats and species observed during the 2017 Fugro survey are reported below. Two OSPAR listed habitats/species of which one is also a PMF were recorded along with one PMF.

Ocean Quahog (*Arctica islandica)*

The ocean quahog (*Arctica islandica*) is listed as a Scottish PMF (SNH 2017) and is also listed on the OSPAR list of Threatened and/or Declining Species and Habitats (OSPAR 2008). During the Fugro (2017) survey, ocean quahog shells were observed on the sediment surface within the development area. Photographic data showed no evidence of visible ocean quahog siphons on the seabed surface but as the species is known to retract their siphons from the seabed surface, the lack of visible siphons does not confirm their absence. Two individuals (in total) were observed within grab samples at two stations within the survey area.

The sediment type within the development area is suitable for ocean quahog aggregations; and given that the East of Gannet and Montrose NCMPA is relatively close to the field, designated for the protection of this species, it is possible that aggregations of ocean quahog are present near or within the development area. From the 2017 survey results currently available (seabed photographs & visual descriptions of grab samples) it is not possible to determine whether there are ocean quahog aggregations in the development area. The lack of visible siphons and acquisition of only two visible individuals in grab samples could suggest that aggregations are not present. However, laboratory analysis will enable identification of ocean quahogs within the sediment samples, which were not seen in photographic data taken in the field. Until this data is available the presence or absence of aggregations cannot be fully determined. The final survey reports will be available at the end of April 2018 and full details will be included in future drilling and pipeline permits.

Sea Pens and Burrowing Megafauna Communities

Due to the observation of the sea pens *Pennatula phosphorea* and *Virgularia mirabilis*, and Norway lobster (*N. norvegicus*) and their burrows, there is a potential for the presence of the OSPAR listed threatened and/or declining habitat 'sea pens and burrowing megafauna communities' to occur within the development area. Seapens and burrowing megafauna in circalittoral fine mud is also considered a PMF, however this was not recorded due to the absence of fine mud in the development area.

Although the sediments within the survey area were burrowed (at varied densities), mounds with conspicuous burrows did not appear to form a prominent feature of the sediments (Fugro 2017). Most of the burrows within the survey area were small and did not create a prominent feature of the seabed that indicates heavy bioturbation by larger burrowing megafauna. Therefore, the level of bioturbation did not match the JNCC criteria for the 'sea pens and burrowing megafauna communities' habitat (Fugro 2017).

Offshore subtidal sands and gravels (PMF)

Offshore subtidal sands and gravels is a PMF habitat that has been identified as potentially occurring in the development area. This is a broad scale habitat which comprises many component biotopes or species thought to be of conservation importance and is widely distributed in the North Sea (Fugro 2017).

4.4.2 Plankton

Plankton comprises aquatic organisms which are incapable of swimming against a current. They include two main groups: phytoplankton (photosynthetic organisms, responsible for primary production, also termed autotrophs) and zooplankton (which either graze on phytoplankton or are predatory, termed as heterotrophs); however, some species (termed mixotrophs) are intermediate. The composition and abundance of plankton communities varies throughout the year and is influenced by physical parameters such as temperature, salinity and water inflow (Beare *et al*. 2002).

Phytoplankton and the associated grazing zooplankton usually show a bimodal pattern of abundance through the year. The main peak of plankton abundance occurs towards the end of spring in response to increased light, with a secondary peak in abundance occurring in late summer/early autumn (Johns and Reid 2001). The increase in phytoplankton productivity known as the spring diatom bloom reaches its peak during May and is followed by a sharp decline in June (Heath *et al.* 2000). The spring bloom in the CNS is stronger, relative to the autumn bloom, than elsewhere (DECC 2016).

The phytoplankton in the CNS is dominated by the dinoflagellate genus *Ceratium*, along with the diatom genera *Thalassiosira*, *Protoperidinium* and *Chaetoceros* (Johns & Reid 2001).

The zooplankton in the CNS exhibits a seasonal and geographical variation in abundance and distribution that is closely linked to the over-wintering predatory species and food availability. Zooplankton distribution is also strongly influenced by the current system in the area. This enables large concentrations of copepods to be brought into the area from the north-east Atlantic.

The zooplankton community in the CNS is dominated by copepods, with *Parapseudocalanus*, *Acartia* and the younger stages of *Calanus* most abundant (Johns & Reid 2001). There is a clear geographical divide between the copepod *Calanus finmarchicus* and *Calanus helgolandicus. C. finmarchicus* is abundant in colder and northern waters in the North Sea, while *C. helgolandicus* is present within warmer waters in southerly regions (DECC 2016). Regional Sea 1, where Vorlich is located, is characterised by deep, cool and stratified waters, supporting a rich diversity of zooplankton species (DECC 2016). *C. finmarchicus* and *C. helgolandicus* are both present and represent the dominant zooplankton species (DECC 2016).

The larger zooplankton, known as megaplankton, includes euphausiids (krill), salps and doliolids, colonial hydrozoans and jellyfish. The larval stages of invertebrates and some fish also constitute an important part of the zooplankton, known as meroplankton. Soft bodied zooplankton, such as salps are known to peak in abundance in late summer to mid-Autumn (Johns & Reid 2001, Fugro 2016).

The plankton community of the North Sea, in general, has changed in recent times. Inflow of oceanic waters into the North Sea has been associated with an increase of warm water species and decrease of cold boreal species (Johns & Reid 2001, Fugro 2016).

4.4.3 Fish and shellfish

Over 330 species of fish have been recorded on the UK continental shelf (DECC 2016). Fish communities comprise species with complex interactions with both one another, and the natural environment. These species act as predators, consuming a wide range of prey species including benthic invertebrates, and/or as prey supporting larger predators (DTI 2001). The majority of published information on distribution is concerned with commercial fish; however, recent data (Ellis *et al.* 2012) includes some consideration of species of conservation, rather than commercial, significance.

Statistical information for UKCS fishing is published by the Scottish Government, based on International Council for the Exploration of the Sea (ICES) statistical rectangles. These are a grid of (Mercator projection) 1˚ latitude by 0.5˚ longitude rectangles covering the north-east Atlantic. Returns for ICES rectangles indicate species landed, by tonnage and value. It should be noted that these do not provide a definitive guide to the fish and shellfish in an area and they include no information on species which are not commercially exploited. However, as many of the species found in the CNS are commercially exploitable, it does serve as a useful indicator. The following section is based on the information for rectangle 42F2, within which the development area lies, for the period 2012 to 2016. Section 4.5.1 presents an analysis of fisheries statistics for these years.

4.4.3.1 Ray-finned fish

Table 4-1 lists ray-finned fish which have been reported as landed from rectangle 42F2 between 2012 and 2016 and includes the reported tonnage landed, as an analogue for occurrence.

Table 4-1 Ray-finned fish recorded in catch statistics between 2012 and 2016

Species common name	Scientific name	Habitat	Quantity (tonnes)
Anglerfishes†	*Lophiidae*	Demersal	5.61
Atlantic cod†	*Gadus morhua*	Demersal	12.55
Atlantic halibut	*Hippoglossus hippoglossus*	Demersal	0.09
Atlantic herring†	*Clupea harengus*	Pelagic	127.97
Atlantic mackerel†	*Scomber scombrus*	Pelagic	5
Brill	*Scophthalmus rhombus*	Demersal	0.02
Catfish	*Siluriformes*	Demersal	0.18
Common ling†	*Molva molva*	Demersal	0.04
European hake	*Merluccius merluccius*	Demersal	0.13
European plaice	*Platessa platessa*	Demersal	189.59
Grey gurnards	*Eutrigla gurnardus*	Demersal	3
Haddock	*Melanogrammus aeglefinus*	Demersal	198.99
Lemon sole	*Microstomus kitt*	Demersal	134.76
Red mullet	*Mullus surmuletus*	Demersal	0.01
Saithe	*Pollachius virens*	Demersal	1.27
Sole	*Soleidae*	Demersal	0.01
Turbot	*Psetta maxima*	Demersal	0.33
Whiting	*Merlangius merlangus*	Demersal	3.01

The Scottish Government 2017; †Denotes species listed as PMFs.

The majority of ray-finned fish taken in the area are demersal, i.e. dwelling on or near the seabed and largely reliant on the benthos for food and protection. Two pelagic species (i.e., mid and upper water species, feeding in the water column) have been reported among landings; Atlantic herring and Atlantic mackerel. Atlantic herring form a relatively large portion of the catch.

4.4.3.2 Sharks, rays and skates (elasmobranchs)

The term elasmobranch refers to species of cartilaginous fish such as sharks, rays and skates, a number of which are found in the CNS. A study by Dann *et al.* (2005) found the most abundant species in the North Sea to include the spiny dogfish, lesser spotted dogfish, starry ray and the spotted ray (Fugro 2016). The development area is host to a year-round nursery ground for spurdog and spotted ray (Ellis *et al.* 2011).

4.4.3.3 Shellfish

Shellfish species in the CNS are dominated by Norway lobster (*Nephrops norvegicus)*. The development area is near to the soft and sandy sediment of the south-east corner of the Fladen Grounds which provide an important habitat for *Nephrops* and pink shrimp (DECC 2009, Fugro 2016). A number of important commercial and non-commercial fish stocks are known to be found within the development area. Further details of commercial fish stocks are provided in section 4.5.1.

4.4.3.4 Spawning and nursing

Fish are most likely to be affected by the planned development in their early stages of life, either as eggs, larvae or juveniles; adults are likely to be able to avoid the development area during potentially harmful activity. Demersal spawning species lay their eggs on the seabed, in specific substrate types, and therefore may be vulnerable to seabed disturbance. Pelagic spawners release their eggs into the water column, where they form part of the plankton. Most species of commercially exploited fish (both demersal and pelagic) are planktonic in their larval and early juvenile phases. Planktonic phase fish are potentially vulnerable to inputs (energy or contaminants) entering the water column, but tend to be spread over wide areas. Planktonic phase fish are a primary food source for many marine species.

Fisheries sensitivity maps (Ellis *et al.* 2012, Coull *et al*. 1998) have been used to identify the spawning (location where eggs are laid) and nursery grounds (location where juveniles are common) for commercial fish species in the development area. Table 4-2 shows which species are likely to be present.

The likelihood for presence of juveniles within the first year of their life near the development area has been determined to be low for all species using Aires *et al*. (2014).

Fish species likely to be spawning and/or nursing in the development area

Fish Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish†	N	N	N	N	N	N	N	N	N	N	N	N
Atlantic cod†	SN	SN*	SN*	SN	N	N	N	N	N	N	N	N
Atlantic herring†	N	N	N	N	N	N	N	N	N	N	N	N
Atlantic mackerel†	N	N	N	N	SN*	SN*	SN*	SN	N	N	N	N
Blue whiting†	N	N	N	N	N	N	N	N	N	N	N	N
Common ling†	N	N	N	N	N	N	N	N	N	N	N	N
European hake	N	N	N	N	N	N	N	N	N	N	N	N
Haddock	N	N	N	N	N	N	N	N	N	N	N	N
Lemon sole				S*	S*	S*	S	S	S			
Norway pout	SN	SN*	SN*	SN	N	N	N	N	N	N	N	N
European plaice	SN*	SN*	SN	N	N	N	N	N	N	N	N	SN
Sandeel†	SN	SN	N	N	N	N	N	N	N	N	SN	SN
Spotted ray	N	N	N	N	N	N	N	N	N	N	N	N
Spurdog	N	N	N	N	N	N	N	N	N	N	N	N

Ellis *et al.* 2012, Coull *et al.* 1998; * = Peak Spawning; †PMF species.

4.4.3.1 Protected or vulnerable species

Seven species listed in Table 4-2 (above) are included on the list of PMFs, as defined by Scottish Natural Heritage (2014), and are therefore considered to be of conservation importance. Three PMF species are likely to spawn within the development area; Atlantic cod, Atlantic mackerel and sandeel. However, in González-Irusta and Wright (2016) it is identified that there is an extensive area of the CNS that is unfavourable habitat type for spawning Atlantic cod. Additionally, sandeels (*Ammodytes marinus* and *A. tobianus.*) are unlikely to be present, *A. tobianus* does not occur offshore and *A. marinus* are not found in the water depths present at the development area (Lancaster *et al.* 2014).

In addition, Atlantic herring, Atlantic cod, Atlantic mackerel, common ling, European hake, European plaice and whiting are included on the UK Biodiversity Action Plan (UKBAP) list of priority species. These species are identified as among those in the UK which are the most threatened and requiring conservation action under the UK BAP.

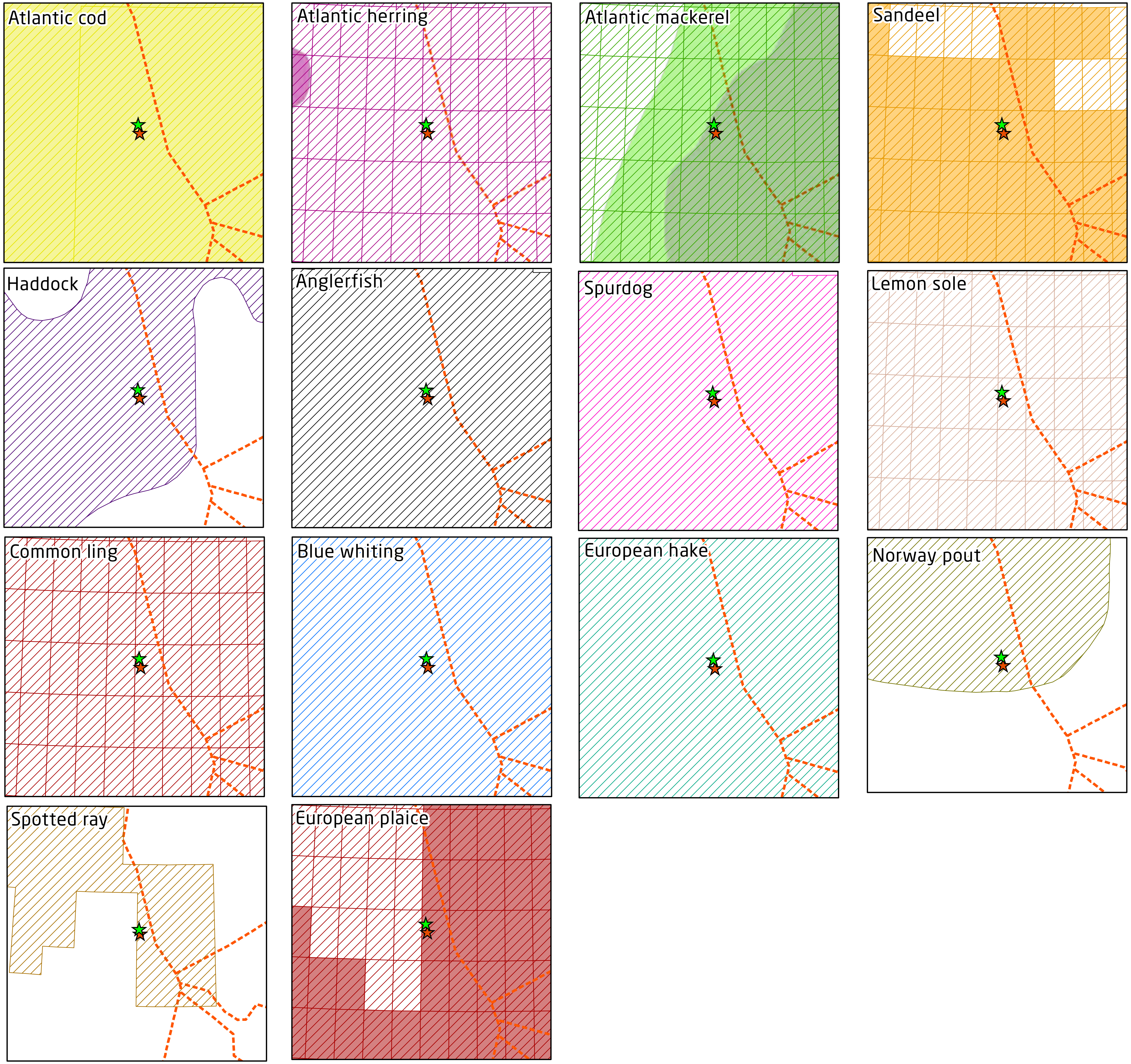

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Figure 4-8: Spawning and Nursing Species in the vicinity of Vorlich

Legend

- Vorlich Drill Centre
- FPF-1
- Median Line

Cod
- Nursery
- Spawning

Norway pout
- Nursery

Haddock
- Nursery

Spotted ray
- Nursery

Sole
- Nursery

Plaice
- Nursery
- Spawning

Spurdog
- Nursery

Ling
- Ling

European hake
- Nursery

Blue whiting
- Nursery

Anglerfish
- Nursery

Sandeel
- Nursery
- Spawning

Herring
- Nursery
- Spawning

Mackerel
- Nursery
- High Spawning Intensity
- Low Spawning Intensity

Date	Wednesday, March 7, 2018 09:44:25
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	CDA, GEBCO, CEFAS
File Reference	J:\P2206\Mxd\ Fish_Spawning_and_Nursery_v2.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Patricia Adams

km 0 25 50 100 150 200

© The GEBCO Digital Atlas published by the British Oceanographic Data Centre on behalf of IOC and IHO, 2003. Contains public sector information licensed under Open Government Licence v3.0. Data from Ellis, J.R. et al. (2012) Spawning and Nursery Grounds of Selected Fish Species in UK Waters. CEFAS Lowestoft Science Series Technical Report, 147: 55pp.

4.4.4 Seabirds

Seabirds are present in the CNS throughout the year, with abundance of individual species dependent on breeding periods and prey species availability (DECC 2016). Seabirds commonly sighted within the CNS include northern gannet (*Morus bassanus*), European storm petrel (*Hydrobates pelagicus*), common guillemot (*Uria aalge*), northern fulmar (*Fulmarus glacialis*), great skua (*Catharacta skua*), black-legged kittiwake (*Rissa tridactyla*), great black backed gull (*Larus marinus*) and European herring gull (*Larus argentatus*) (Stone *et al.* 1995; DECC 2016).

4.4.4.1 Offshore species

Seabirds found in offshore areas include members of several families, most notably the petrels and shearwaters, gannets, gulls, skuas and auks. These birds breed on the coasts of the UK, but frequently feed far offshore.

The most abundant bird species recorded in the waters around the development area are northern fulmar, black-legged kittiwake, gannet, common guillemot and puffin (BODC 1998). A number of other species, particularly other gulls and skuas, also occur in lower densities at certain times of year. Seabird abundance observed at sea near the development area is highest from July to October (Fugro 2016).

4.4.4.2 Coastal species

The coastline adjacent to the development area is designated as the Buchan Ness to Collieston Coast Special Protection Area (SPA). Although the SPA is approximately 240km to the west, birds may use the surrounding region for feeding. The SPA qualifies under the EC Birds Directive by regularly supporting at least 20,000 seabirds, which is classed as a "seabird assemblage of international importance". The site is of importance as a nesting area for seabird species such as gulls and auks. These birds feed outside the SPA in the nearby waters, as well as more distantly. During the breeding season, the area regularly supports 95,000 individual seabirds including: common guillemot (*Uria aalge*), black-legged kittiwake (*Rissa tridactyla*), herring gull (*Larus argentatus*), European shag (*Phalacrocorax aristotelis*) and northern fulmar (*Fulmarus glacialis*) (JNCC 2005). Of these species, only northern fulmar is likely to be observed within the development area (foraging distance of 580km, Thaxter *et al*. 2012). However, numbers of this species from this site are likely to be low given the distance.

4.4.4.3 Sensitivity of marine birds

Seabirds are sensitive to changes in the quality of the marine environment, especially to changes in fish stocks (which could affect food sources) and to oil pollution. Seabird sensitivity has been assessed for the development area (Blocks 30/1, 30/6 and the surrounding nine Blocks) using the Seabird Oil Sensitivity Index (SOSI). The index identifies areas at sea where seabirds are likely to be most sensitive to oil pollution by looking at offshore densities (based on seabird survey data from 1995 to 2015) and species sensitivity. Species sensitivity takes into consideration factors such as habitat flexibility (a species ability to locate to alternative feeding sites), adult survival rate, potential annual productivity, and the proportion of the biogeographical population in the UK. The combined seabird data and species sensitivity index values are subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution.

SOSI in Blocks 30/1 and 30/6 is low for the duration of the year (Figure 4-9, Webb *et al.* 2016). An overall summary of the seabird sensitivity within and surround the development area is presented in Table 4-3 below.

Table 4-2 Seabird oil sensitivity in the development area and surrounding region

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
29/5	-	5	5	-	-	5	5	5	5	-	-	-
22/30	5	5	5	-	-	5	5	5	5	-	-	-
30/2	5	5	-	-	-	5	5	5	-	-	-	-
23/27	5	5	-	-	-	5	5	5	5	-	-	-
30/1	-	5	-	-	-	5	5	5	-	-	-	-
29/10	-	5	5	-	-	5	5	5	-	-	-	-
30/6	-	5	-	-	-	5	5	5	-	-	-	-
23/26	5	5	-	-	-	5	5	5	3	-	-	-
30/7	5	5	-	-	-	5	5	5	-	-	-	-
30/12	5	4	5	-	-	5	5	5	-	-	-	-
30/11	-	5	5	-	-	5	5	5	-	-	-	-
29/15	-	5	5	-	-	5	5	5	-	-	-	-

Key: 1 = extremely high, 2 = very high, 3 = high, 4 = moderate and 5 = low. "-" denotes no data available.

Source: Webb *et al.* 2016

4.4.4.4 Protected species

The majority of seabirds which occur on the UKCS are included either in Annex I (threatened bird species) of the EC Birds Directive or are regularly occurring migratory species. The directive requires that Special Protection Areas (SPA) should be established to conserve these species. There are no SPAs or dSPAs within 40km of the development area; the closest SPA is Buchan Ness to Collieston Coast SPA, 244km to the west.

There are 59 species of birds which are listed on the UK BAP list of priority species (Defra 2007). Of these, Arctic skua are included among the species present within the development area, however they are not likely to be present in large numbers as the area is outside their normal range. Whilst this species has been identified as a priority species it does not have a specific species action plan as yet, despite showing a marked decline in the UK (JNCC 2010).

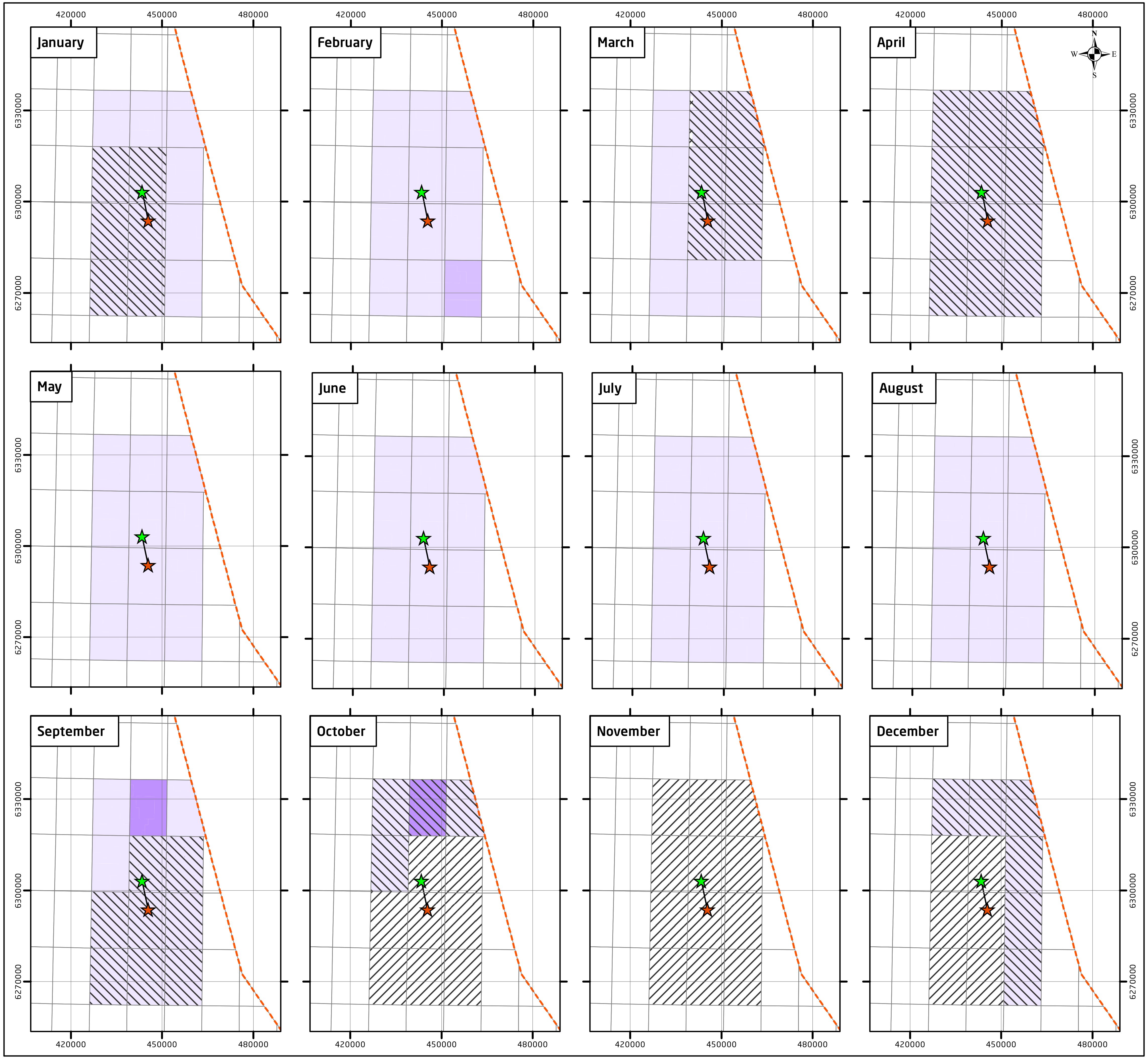

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Figure 4-9: Seabird Sensitivities

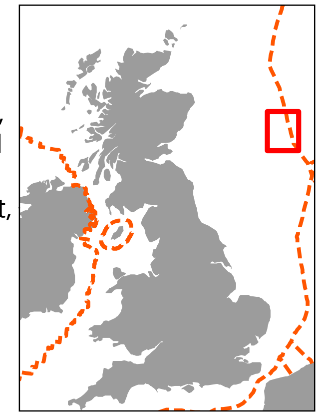
Legend

- Median Line
- Vorlich Drill Centre
- FPF-1
- Vorlich Pipeline
- Licence Block

Median Seabird Oil Sensitivity

- Interpolated Data
- No Data
- Low
- Medium
- High
- Very High
- Extremely High

NOTE: January and March sensitivity data are interpolated from February, April data are interpolated from May, September data are interpolated from August, October from September, and December from January.



NOTE: Not to be used for Navigation

Date	Wednesday, March 7, 2018 09:55:22
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	JNCC, CDA, ESRI
File Reference	J:\P2206\Mxd\ Seabird_Vulnerability.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Kerri Gardiner

km
0 10 20 30 40

Certain, G., Jørgensen, L.L., Christel, I., Planque, B. & Bretagnolle, V. 2015. Mapping the vulnerability of animal community to pressure in marine systems: disentangling pressure types and integrating their impact from the individual to the community level. ICES Journal of Marine Science, 13pp.

4.4.5 Marine mammals and reptiles

Marine mammals present in the development area are restricted to cetaceans (whales, dolphins and porpoises) and pinnipeds (seals). Chelonians (marine turtles) are the only type of reptile that may potentially be encountered.

4.4.5.1 Cetaceans

Twenty eight cetacean species have been recorded in UK waters from sightings and strandings. Of these, eleven are known to occur regularly (DECC 2016). Cetacean abundance in the CNS is relatively low compared to other north-western European waters and both the number of species and the frequency of sightings (taken here as a measure of abundance) tends to decrease southwards through the North Sea. Sightings data suggests that:

- Harbour porpoise (*Phocoena phocoena*) and Atlantic white-beaked dolphin (*Lagenorhynchus albirostris*) are considered to be resident in the CNS, and are likely to be present in the development area in moderate to low densities from June to October and May to November, respectively;
- Minke whale (*Balaenoptera acutorostrata*) and Atlantic white-sided dolphin (*Lagenorhynchus acutus)* are likely to be present in low densities from February to April and July to September, respectively.

Table 4-3 Cetacean sightings within the development area

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atlantic white-beaked dolphin												
Atlantic white-sided dolphin												
Harbour porpoise												
Minke whale												
Key	High densities				Moderate densities				Low densities			

Source: Reid et al. 2003

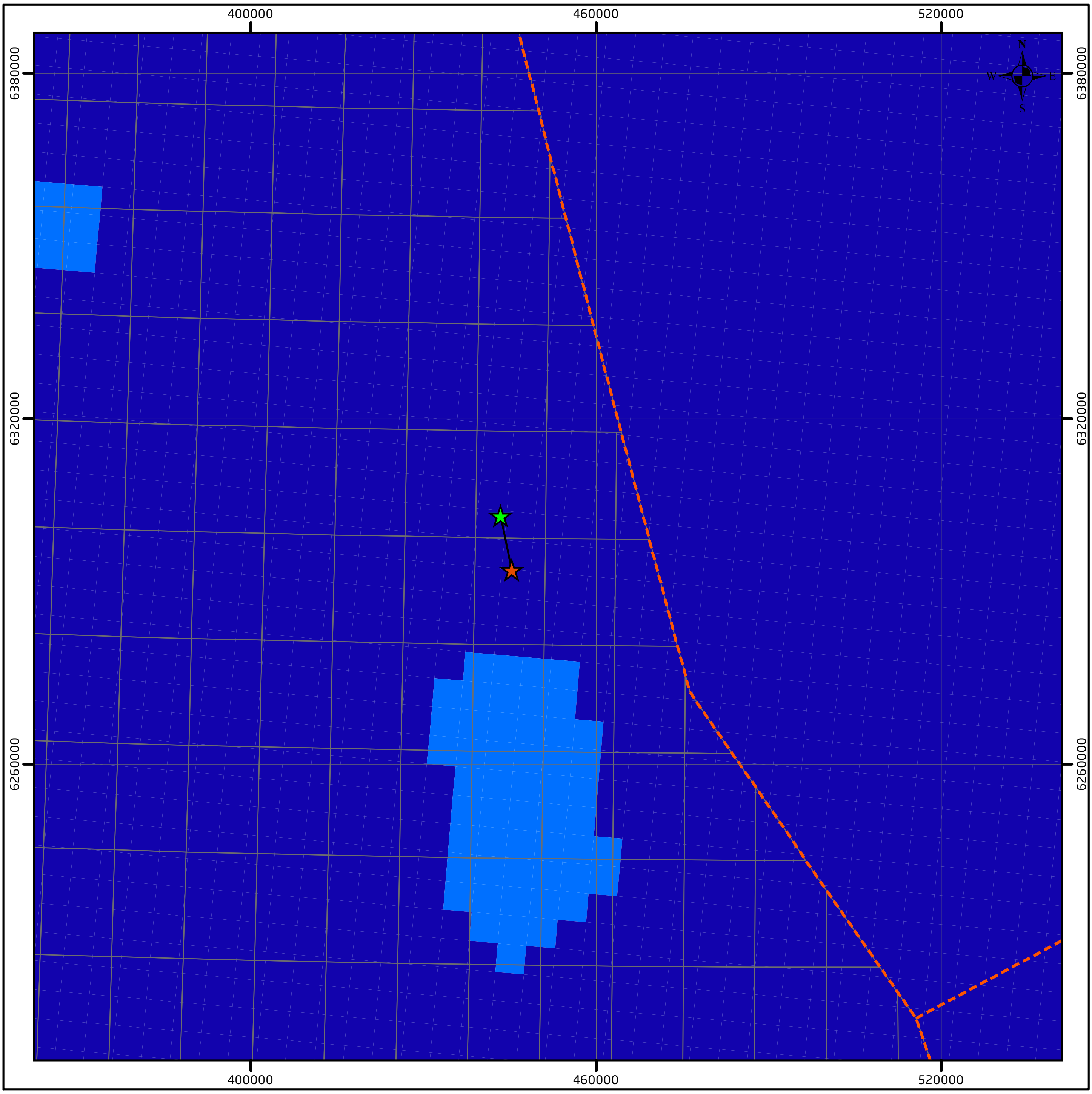
The recent SCANS III estimates (summer 2016) for cetacean abundance in European Atlantic water shows that for the development area, the species present in the highest densities were harbour porpoise (0.599 individuals/km^2), Atlantic white-beaked dolphin (0.243 individuals/km^2) and minke whale (0.039 individuals/km^2) (Hammond *et al.* 2017).

4.4.5.2 Pinnipeds

Two species of pinniped occur in the CNS: common or harbour seal (*Phoca vitulina*) and grey seal (*Halichoerus grypus*). Distribution of common and grey seals are presented in Figure 4-10 and Figure 4-11, respectively.

The distribution of common seal at sea is limited by the need to return to land periodically. Until recently, data suggested they were unlikely to be found more than 60km from the coast, although recent telemetry studies show a wider distribution across the North Sea. The Marine Planning Portal (Marine Management Organisation 2016) indicates that common seal densities in the development area are low (<1 seal per 5km^2). Common seal are found in all coastal waters around the North Sea and there are important breeding and haul out sites for common seal on the CNS coast. The closest is Fast Castle on the east coast of Scotland; however, this is approximately 275km from the development area.

Grey seal have a wide distribution across the north-western Atlantic, Baltic and northeast Atlantic seas. Populations in the North Sea account for approximately 50% (~70,000 individuals) of the northeast Atlantic population and 38% of the global population (DECC 2016). Grey seal are mainly distributed around and between haul-out sites and foraging areas and are commonly seen in the CNS and NNS (DECC 2016). Grey seal densities in the development area are low (<1 seal per $5km^2$).



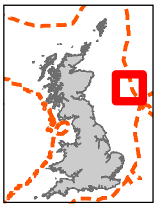
Legend

- Vorlich Drill Centre
- FPF-1
- Vorlich Pipeline
- Median Line
- Licence Block

Harbour Seal (Phoca Vitulina) At-Sea Estimated Usage

Average Predicted Number of Seals

- 0 - 1
- 1 - 5



NOTE: Not to be used for Navigation

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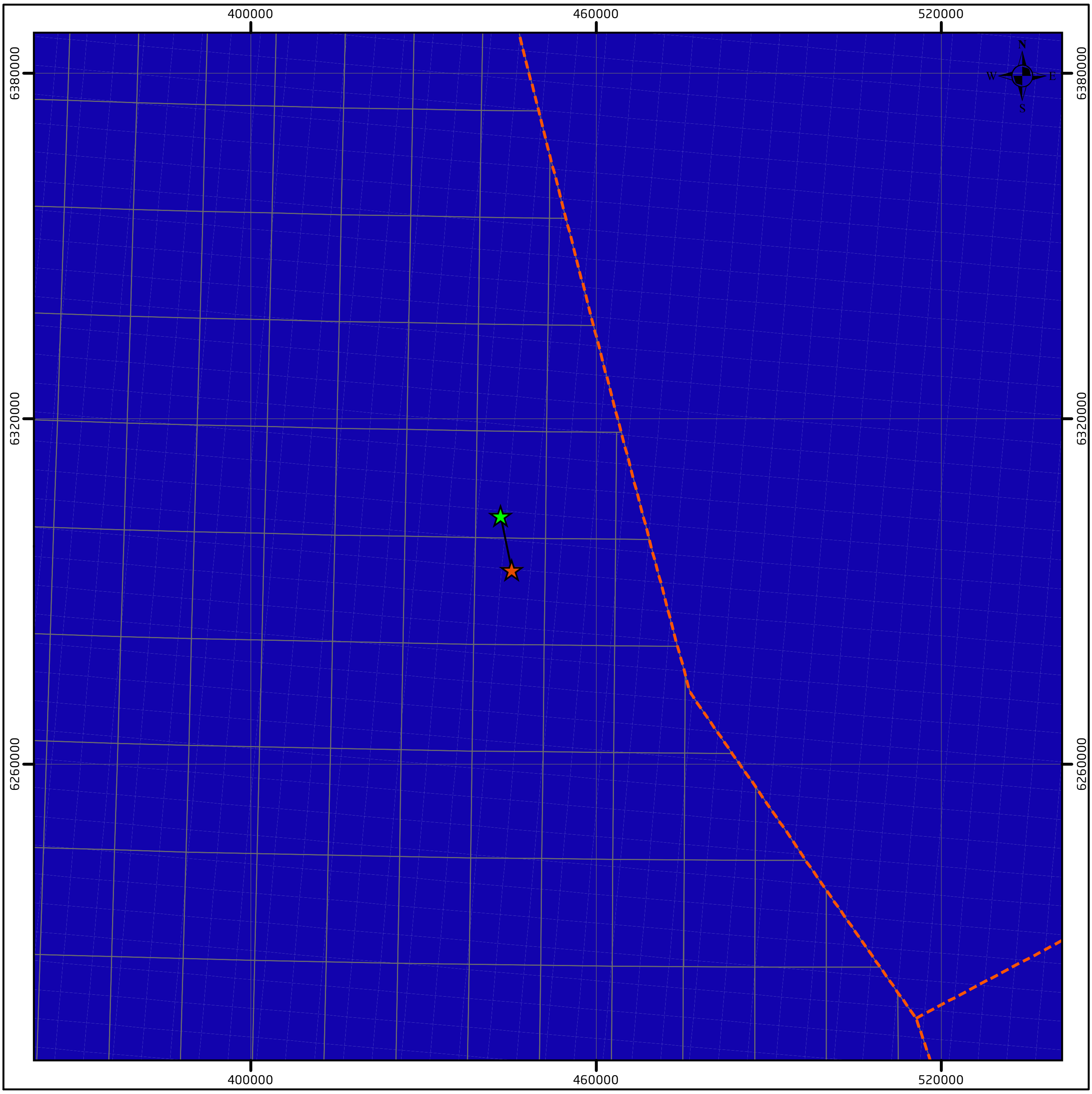
Figure 4-10: Common/Harbour Seal Distribution near the Development Area

Date	Wednesday, March 7, 2018 09:40:58
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	CDA, OSOD, ESRI, SMRU
File Reference	J:\P2206\Mxd\ Common_Seal.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Kerri Gardiner

bp intertek

km 0 9 18 27 36 45



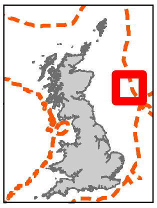
Legend

- Vorlich Drill Centre
- FPF-1
- Vorlich Pipeline
- Median Line
- Licence Block

Grey Seal (Halichoerus grypus) At-Sea Estimated Usage

Average Predicted Number of Seals

- 0 - 1



NOTE: Not to be used for Navigation

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Figure 4-11: Grey Seal Distribution Near the Development Area

Date	Wednesday, March 7, 2018 09:47:52
Projection	ED_1950_UTM_Zone_31N
Spheroid	International_1924
Datum	D_European_1950
Data Source	CDA, OSOD, ESRI, SMRU
File Reference	J:\P2206\Mxd\ Grey_Seal.mxd
Created By	Jennifer Arthur
Reviewed By	Richard Marlow
Approved By	Kerri Gardiner

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km
0 9 18 27 36 45

4.4.5.3 Chelonians

Marine turtles are the only marine reptiles found in UK waters. Of the seven species of marine turtle in the world, five have been recorded in UK waters; the Leatherback sea turtle (*Dermochelys coriacea*), Loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*), and Green sea turtle (*Chelonia mydas*). Of these, only the Leatherback turtle is a regular visitor, with occasional sightings in the North Sea. These turtles are increasingly spending time in UK waters as a result of increasing water temperatures and greater presence of the jellyfish and other gelatinous zooplankton that they prey on. In Regional Sea 1, where the development area is located, the majority of leatherback turtle sightings between 2000 and 2011 were coastal, namely within the Humber estuary (380km to the southwest) and the Moray Firth (370km to the northwest) (DECC 2016).

4.4.5.4 Protected species

All cetaceans and marine turtles are European Protected Species (EPS) protected under Annex IV of EC Directive 1992/43/EEC (Habitats Directive), which lists species of Community Interest in need of strict protection. It is an offence to deliberately capture, kill, injure or disturb animals classed as EPS.

Harbour porpoise, bottlenose dolphin, grey seal and common seal are listed under Annex II of the Habitats Directive, which lists species whose conservation requires designation of SAC. The closest SAC designated for pinniped (grey seal) is the Berwickshire and North Northumberland Coast SAC, approximately 250km southwest of the development area; and for cetaceans, the SNS candidate SAC designated for harbour porpoise, approximately 161km south.

4.5 Socio-economic enviroment

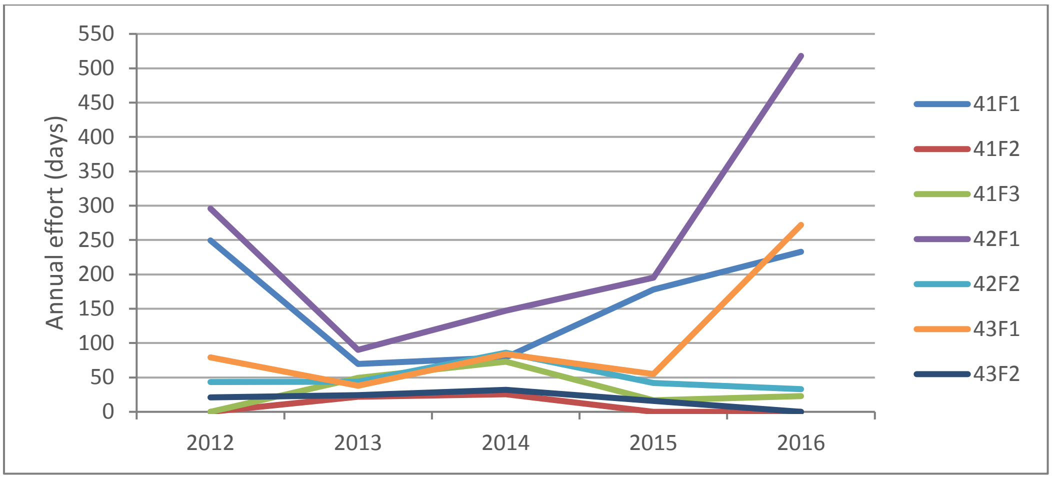
4.5.1 Commercial Fisheries

Over 100 species of fish are commercially exploited in the North Sea. Of these around thirteen species are the main targets for commercial fishing, either for direct human consumption or for conversion into fish meal and oil (OSPAR Commission 2000). As discussed in Section 4.4.3, the development area lies within ICES rectangle 42F2.

4.5.1.1 Effort

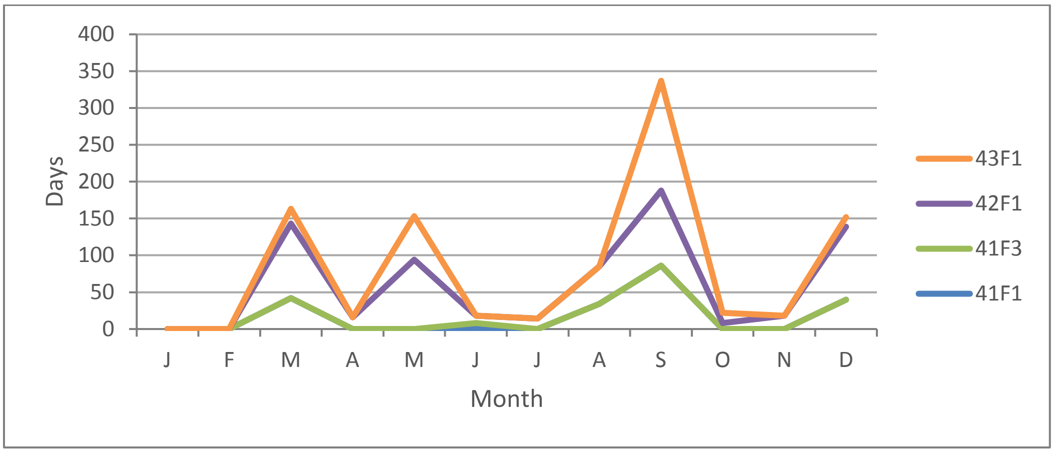
An assessment of fishing effort over a five-year period provides an indication of trends in commercial fishing activity within and surrounding the development area. Annual fishing effort in ICES rectangle 42F2 is typically lower than in the neighbouring ICES rectangles, with an average of 49 days annual effort in the last five years. Over this period, effort was highest in 2016 but stayed relatively constant for the remaining four years (Figure 4-12). Monthly statistics for fishing effort were not available for ICES rectangle 42F2, or for some of the surrounding rectangles. However, seasonal variations in fishing effort in four of the surrounding ICES rectangles (Figure 4-13) shows that the majority of activity occurs during September.

Figure 4-12 Annual fishing effort within and surrounding ICES rectangle 42F2 (2012-2016)



Source: The Scottish Government 2017

Figure 4-13 Seasonal fishing effort within and surrounding ICES rectangle 42F2 (2016)



Source: The Scottish Government 2017

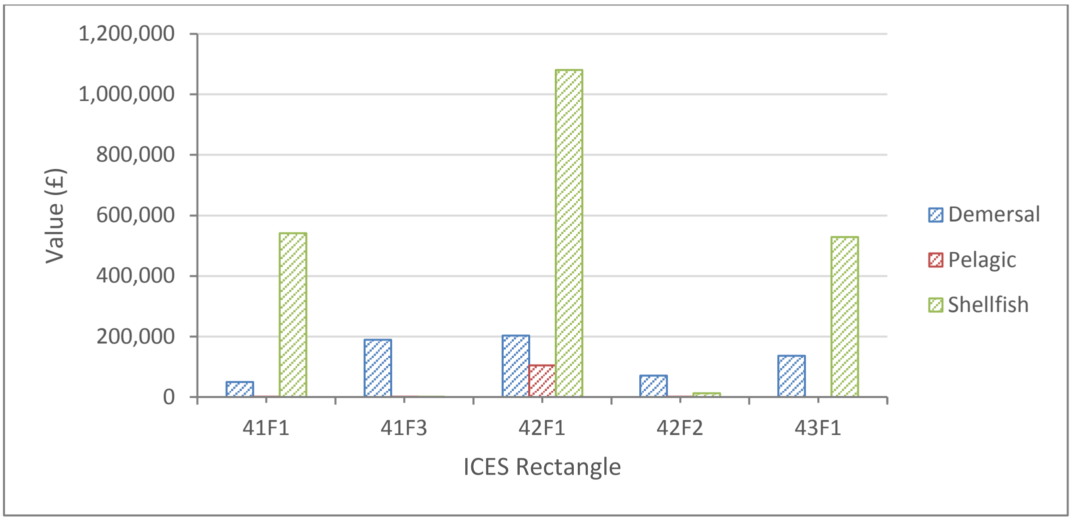
Note: Indicative only as data set contained disclosive data.

4.5.1.2 Landings

The average annual value of all landings from within ICES rectangle 42F2 between 2012 and 2016 was around £171,245 with an average of 142 tonnes landed (The Scottish Government 2017). The overall catch data is sub-divided into fisheries targeting bottom living (demersal) fish, mid-water and surface (pelagic) fish and shellfish (including squid), with information available at species level within each group. Landing tonnages and their respective values provide a good indication of the relative importance of both fisheries and species within and between areas.

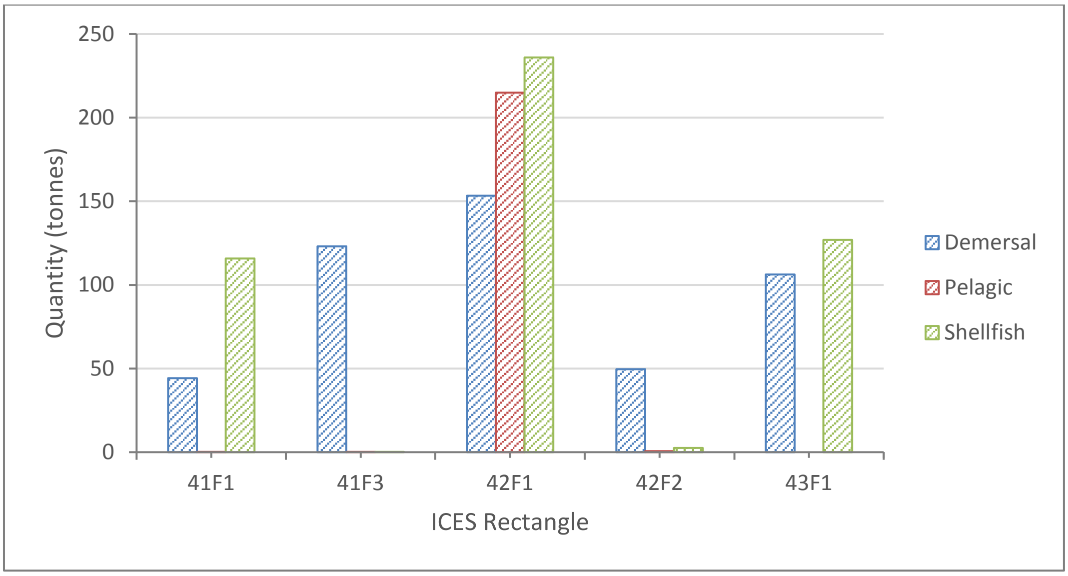
Figures 4-14 and 4-15 provide an overview of the value and mass of landings by fishery in and around ICES rectangle 42F2 in 2016. Overall, the most important fishery is demersal, in terms of both quantity and value, however shellfish are the most important catch for the surrounding rectangles.

Figure 4-14 Annual value by species type within and around ICES rectangle 42F2 for 2016



Source: The Scottish Government (2017)

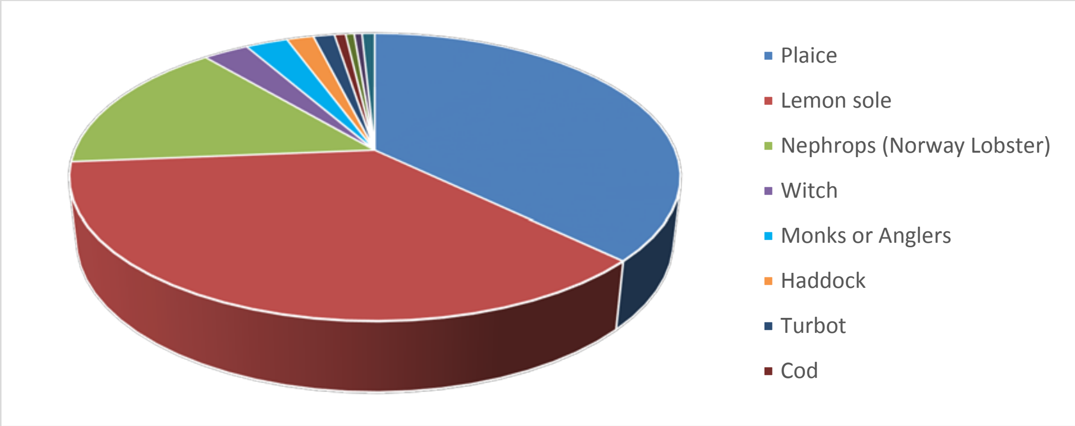
Figure 4-15 Annual catch landed by species type within and around ICES rectangle 42F2 for 2016



Source: The Scottish Government (2017)

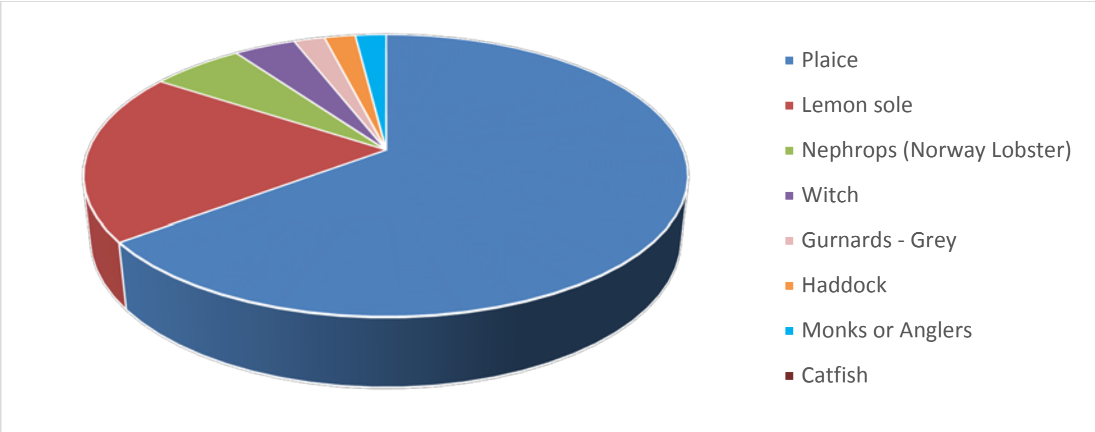
Figures 4-16 and 4-17 show the top seven individual species targeted in ICES rectangle 42F2, by catch value and by landed tonnage respectively. European plaice represents 65% of the tonnage but only 37% of the total value, reflecting a relatively low value per tonne. By contrast the value of Lemon sole landings is close to that of European plaice, with less than a third of the tonnage. Nephrops (Norway lobster) contribute 6% of the total quantity landed for 2016, but this equates to 15% of the total catch value. The remaining catch, while including species which command high prices (Figure 4-15), makes a relatively small contribution to the overall fishery value as tonnages are small. Information from the ICES catch data indicated that in the area where Vorlich is situated (ICES area 25.4.b) in 2015 a total of 819442 tonnes of fish was landed from UK vessels and foreign fishing vessels.

Figure 4-16 2016 top seven species by catch value (£) in ICES rectangle 42F2



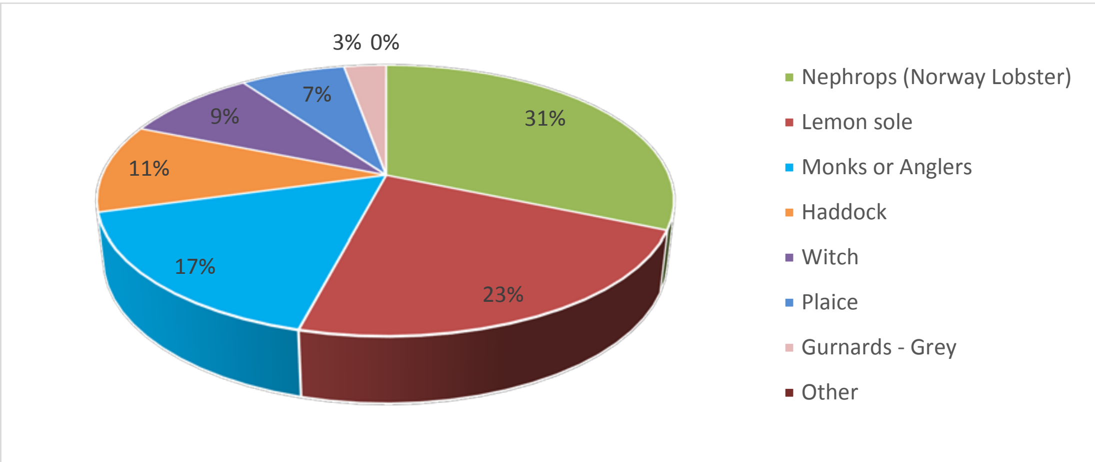
Source: The Scottish Government (2017)

Figure 4-17 2016 top seven species by tonnage landed (t) in ICES rectangle 42F2



Source: The Scottish Government (2017)

Figure 4-18 2016 top seven species by value per tonne (£/t) in ICES rectangle 42F2

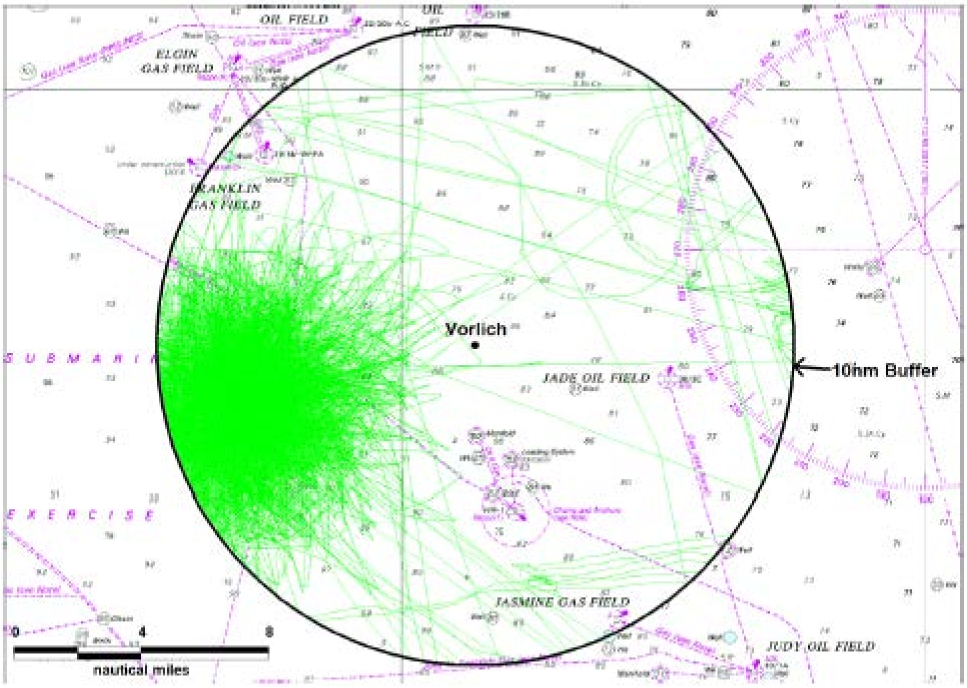


Source: The Scottish Government (2017)

4.5.1.3 Fishing activity

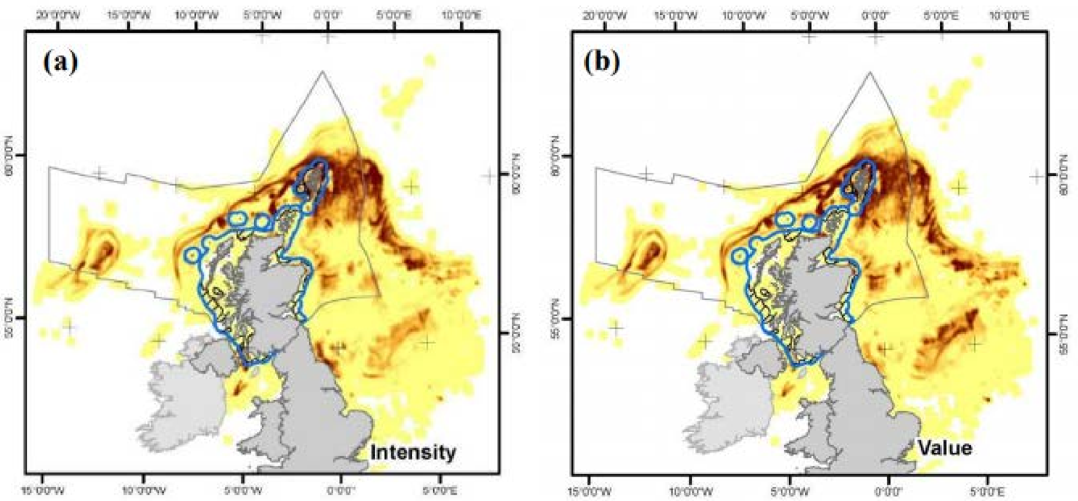
Automatic identification systems (AIS) carriage is mandatory for all fishing vessels 15m and over in length under EC Directive 2002/59/EC. Figure 4-19 indicates that there is substantial fishing activity within 18.5km (10nm) of the development area; however, the majority of activity was to the West and most activity was associated with guard duties at the nearby Puffin wellhead. Other tracks in the area show vessels steaming on passage or engaged in fishing (Anatec 2018). Figure 4-20 also indicates that the development area is in a region of low fishing intensity.

Figure 4-19 Fishing activity within 10nm of Vorlich



Source: Anatec (2018)

Figure 4-20 Fishing intensity in the North Sea



Source: Kafas *et al.* (2012)

4.5.2 Shipping and Navigation

4.5.2.1 Shipping

Localised information on shipping activity around the development area is provided by an Anatec (2018) shipping study. This information is summarised below, see Section 4.5.1 for fishing activity.

There are 30 shipping routes that pass within 18.5km (10nm) of the development area (see Figure 4-21 and Table 4-5), of which 6 pass within 2nm. The total traffic volume on the 30 routes is estimated to be 1,186 vessels per year (average of 3 vessels per day). Most of the vessels are offshore (59%) and cargo (27%). The predominant vessel size is 1,500 to 5,000 deadweight tonnage (DWT).

Table 4-4 Shipping routes passing through the development area

Route	Description	CPA (nm)	CPA (km)	Ships Per Year
1	Aberdeen-Jade*	0.2	0.37	40
2	Kraken-Esbjerg	0.3	0.56	5
3	Forth-Norway S S	1.1	2.04	32
4	Sognefjorden-Humber	1.2	2.22	24
5	Humber-N Norway/Russia*	1.2	2.22	60
6	N Norway/Russia-Tetney	1.9	3.52	10
7	Boknafjorden-Tees*	2.3	4.26	40
8	Tetney-N Norway/Russia	2.3	4.26	10
9	Tyne-Boknafjorden a	2.3	4.26	12
10	Lidköping -Montrose	2.5	4.63	5
11	Boknafjorden-Tyne a	2.7	5.00	12
12	Guillemot-Stella	3.1	5.74	10
13	Stella-Guillemot	3.6	6.67	10
14	Brae-Fulmar*	3.8	7.04	16
15	Baltic-Tay	3.8	7.04	20
16	Humber-Sognefjorden	4.4	8.15	24
17	Norway S-Forth N	4.4	8.15	5
18	Humber-Storfjorden*	4.8	8.90	10
19	Kattegat-Tay	4.8	8.90	65
20	Aberdeen-Stella*	5.1	9.45	140
21	Jasmine-Jade	6.1	11.30	60
22	Alma-Kittiwake*	6.3	11.68	20
23	Curlew-Pierce*	6.4	11.86	16
24	Kattegat-Forth*	7	12.97	155
25	Aberdeen-Jasmine*	7.2	13.34	40
26	Curlew-Shearwater a*	7.5	13.90	40
27	Aberdeen-Judy b*	8.7	16.12	160
28	Chestnut-Rotterdam	8.7	16.12	5
29	Aberdeen-Elgin/Franklin*	9.4	17.42	40
30	Jasmine-Judy*	9.9	18.35	100

*Where two or more routes have identical Closest Point of Approach (CPA) and bearing they have been grouped together. In this case, the description lists the sub-route with the most ships per year.

Anatec (2018)

Figure 4-21 Positions of shipping routes within 10nm of the development area

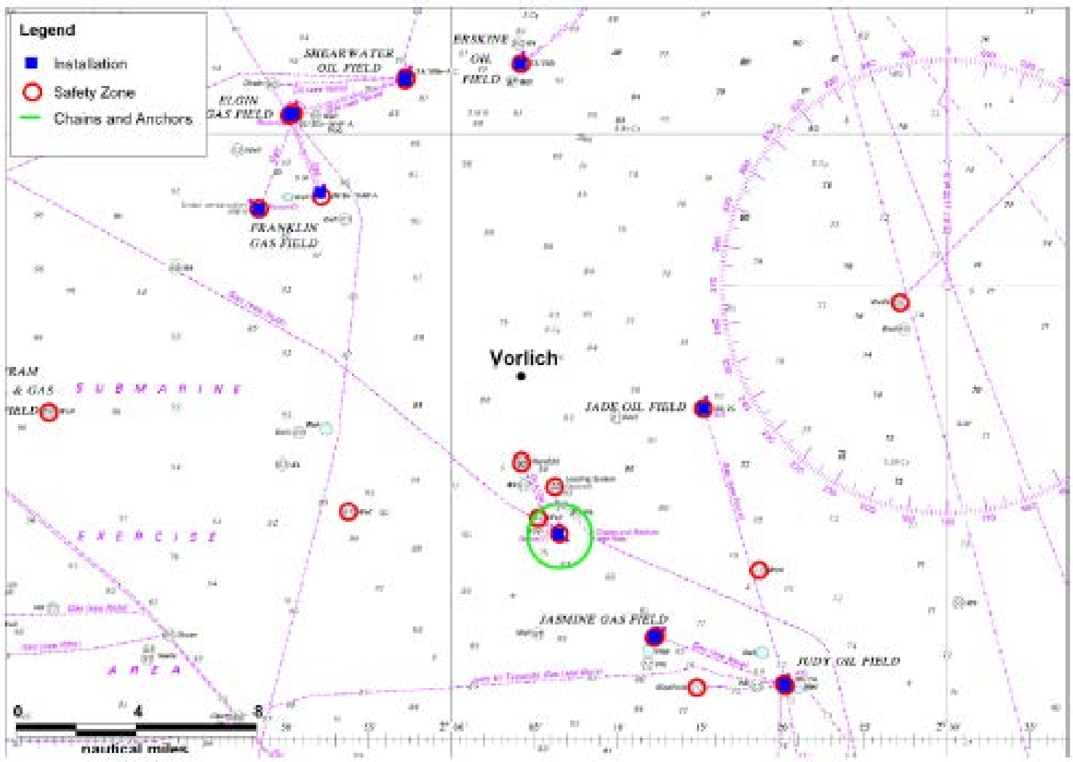
Source: Anatec 2018

4.5.2.2 Navigational features

The main navigational features near the development area are shown in Figure 4-22. The development area is situated within relatively open waters. The nearest surface offshore installations are the Stella FPF-1 5.4nm to the south (part of the proposed development), the Jade platform 6.1nm to the east, the Franklin Platform 9nm to the NW and the Jasmine platform 9.7nm to the SE. There are also other safety zones protecting subsea oil and gas assets in the vicinity, the closest being to the south of Vorlich.

Anatec (2018) reviewed the effect of the development on navigation and concluded that a proportion of vessels on Route numbers 1-6 (see section 4.5.2.1) may be affected. However, there is sea room available surrounding the Vorlich location for passing vessels to safely increase their passing distances to avoid the temporary safety exclusions established around the drilling rig and vessels associated with pipeline installation and tie-in.

Figure 4-22 Navigational features near the development area



Source: Anatec (2018)

4.5.3 Other Marine Users

The CNS is a busy area of the North Sea with regards to the oil and gas industry and other marine users. Other marine users near the development area include:

- Other oil and gas operators – there are 520 existing wells, 17 platforms and 121 pipelines within 40km of the development area.
- The closest windfarm is the Teesside Offshore windfarm area, approximately 193km south.
- The closest marine aggregate area is the Humber Area 506 (application area, not yet licensed), 343km to the south.
- A telecommunications cable, TAMPNET, is located 25km to the southeast of the development area, at its closest point.
- The closest Ministry of Defence Area (MDA) is a the Druridge Bay submarine practice area, 168km to the northeast.
- Recreational yachting activity will be focused in coastal areas and is likely to be light within the development area (The Scottish Government 2018).

5. ENVIRONMENTAL HAZARDS, EFFECTS AND MITIGATION MEASURES

5.1 EIA methodology

The impact assessment has been carried out in three stages as follows:

1. Definition of the existing baseline environment surrounding the project location, in terms of the physical, biological and human environments – see Section 4.
2. Identification of the activities that have the potential to impact the baseline environment and their subsequent assessment. The assessment has been based on the potential severity and likelihood of an impact using the criteria described below. The assessments assume that activities will be carried out in accordance with all current legislation and industry best practice.
3. The potential for transboundary and cumulative impacts have been assessed, both within the proposed operation, or when combined with other external activities.

5.1.1 Impact assessment criteria

Potential environmental impacts have been categorised using severity classes adapted from the environmental risk assessment guidance produced by UKOOA (1999) as presented in Table 5-1.

Table 5-1 Severity classification

Severity class		Criteria
1	Negligible	Change unlikely to be noticed against background variability.
2	Minor	Change within normal variability but could be noticed / monitored. Some users may need to modify behaviour.
3	Moderate	Localised effect but with full recovery back to existing variability. May contribute to cumulative impact. Nuisance potential to some users.
4	Major	Medium term (2 year) change in ecosystem or activity over a wide area with recovery to normal variability likely within 10 years.
5	Severe	Long term (10 year) change to ecosystem over wide area with low probability of recovery to normal range.

These potential impacts have been assessed using a risk matrix shown in Table 5-2, based upon International Standard BS EN ISO 17776:2002. This has been adapted for use by Intertek to provide the criteria for oil and gas operations.

Risk is a term in general usage to express the combination of the likelihood of a specific impact occurring and the severity of the consequences that might be expected to follow from it. For this assessment, the likelihood and severity of the impact is considered once standard mitigation inherent in the design of the operation is incorporated e.g. measures taken to ensure legal compliance.

The assessment considers the possibility that a receptor group may be exposed to several different potential impacts under each activity and that for each impact there may be different combinations of severity and likelihood e.g. low severity and high likelihood or high severity but low likelihood. Risk is scored according to the worst-case combination provided similar mitigation and controls apply to both.

Table 5-2 Risk matrix

Severe [5]	Severity	5-A	5-B	5-C	5-D	5-E
Major [4]		4-A	4-B	4-C	4-D	4-E
Moderate [3]		3-A	3-B	3-C	3-D	3-E
Minor [2]		2-A	2-B	2-C	2-D	2-E
Negligible [1]		1-A	1-B	1-C	1-D	1-E
		Likelihood				
		Very Low [A]	Low [B]	Medium [C]	High [D]	Very High [E]
		Plausible but no known occurrences in the industry	Plausible and believed to have occurred in the industry	Possible (known isolated occurrences in the North Sea region)	Probable (several known occurrences in the North Sea regions)	Very likely (expected to occur)

The coloured zones in Table 5-2 indicate broad risk acceptability and tolerability levels as follows in Table 5-3:

Table 5-3 Risk acceptability levels

(green)	**Acceptable:** Risks are accepted without further reduction other than the routine management process of continual improvement.
(amber)	**Tolerable:** Risks which are acceptable provided that the risks are reduced to As Low As Reasonably Practicable (ALARP).
(red)	**Unacceptable:** Risks cannot be justified under the current criteria.

Impacts are discussed in detail in Section 5.2 onwards and mitigation above that normally adopted through routine environmental management is outlined.

5.1.2 Mitigation of potential impacts

Mitigation measures are the actions or systems that are used, or have been proposed, to manage the potential risks identified. They may take the form of reducing:

- The probability of a triggering event occurring;
- The probability of an event having an impact; and
- The severity of the potential impact.

Mitigation is an integral part of the Vorlich project development. All the potential impacts identified from this project are subjected to either standard recognised best practice mitigation measures or to impact specific, feasible and cost-effective mitigation. The mitigation measures considered pertinent for each environmental and social issue are outlined in the individual technical sections.

5.1.3 Residual impact assessment

The acceptability assessment is repeated taking into consideration the best practice and proposed mitigation measures. This determines whether there is likely to be a residual impact.

Residual impacts assessed as unacceptable or tolerable after consideration of proposed mitigation measures will normally require additional analysis and consultation to discuss and possibly further mitigate impacts where possible. Where further mitigation is not possible a residual impact may remain.

5.1.4 Impact assessment and mitigation measures

The assessment is based on the drilling and pipeline installation programme outlined in Section 3, the development footprint (see individual sections below) and on the environmental baseline described in Section 4. The scores applied during assessment of the risk the activities pose to the environment are summarised in Table 5-5 below.

Table 5-4 Risk matrix - summary of assessment results

	Environmental receptor											
Aspect	**Air quality**	**Water quality**	**Sediment**	**Plankton**	**Benthos**	**Fish and shellfish**	**Seabirds**	**Marine mammals**	**Protected sites**	**Shipping**	**Commercial fisheries**	**Other marine users**
Drilling												
Physical presence										1-D	1-D	1-C
Generation of atmospheric emissions	1-E											
Generation of underwater noise				1-D		1-D		1-A	1-A			
Marine discharges		2-C	2-C	1-B	3-B	3-A		1-A	1-A			
Seabed footprint			1-E		1-E	2-C			1-A		2-C	1-B
Pipeline Installation												
Physical presence										3-B	3-B	3-B
Generation of atmospheric emissions	1-E											
Generation of underwater noise								1-D				
Marine discharges		2-C	2-C		2-C	2-C	2-C		2-C		2-C	2-C
Seabed footprint			1-E		1-E	2-C			1-A		2-C	1-B
Operation												
Generation of atmospheric emissions	1-E											
Marine discharges	No increase in produced water as a result of the development.											

5.2 Physical presence

5.2.1 Impact assessment

This assessment concluded that the risk posed to the environment by the physical presence of the drilling rig and support vessels is acceptable.

A temporary 500m radii safety exclusion zone will be established around the drilling rig for the duration of the drilling operation (approximately 204 days in total) and vessels may be displaced between the FPF-1 and the VDC as vessels travel between the two.

5.2.1.1 Commercial fisheries

The assessment of fisheries statistics indicated that the most important fishery near the development area is demersal, however fishing activity is lower than for the surrounding ICES rectangles. There is potential that fishing vessels may be displaced from their fishing grounds due to the presence of a temporary exclusion zone. However, the area affected is small (0.79km^2) and of limited duration (102 days). It is also possible that fishing may be impacted through the introduction of potential snagging points for fishing nets and trawls.

The pipeline installation operations will be conducted between two 500m radii safety exclusion zones, around the VDC and the FPF-1, as the pipelay vessels travels from the FPF-1 to the manifold. There is the potential for fishing vessels to be displaced from their grounds whilst the vessel travels between these two safety zones.

5.2.1.2 Shipping and navigation

The temporary presence of the drilling rig could place restrictions on navigation and there is potential that vessels may have to re-route passages. The development area is situated in open sea (see Section 4.5.2.1), meaning there is adequate sea room available for vessels to pass at a safe distance. It is expected that due to the activities at the VDC, ships passing along the routes discussed in Section 4.5.2.1, will have to adjust shipping routes, but the navigation change will be temporary and not significant.

The pipeline installation operations have the potential to disrupt shipping routes as the pipelay vessel travels between VDC and FPF-1. Six vessel routes pass within 2nm of the development area, the closest at a mean distance of 0.2nm. The routes are primarily used by oil and gas and construction lay vessels that have a high awareness of offshore activity in their area of operation, especially as they are working at neighbouring fields such as the Harrier and Jasmine field, located 4km to the south and 5km to the east, respectively. Such vessels will typically pass a minimum distance of 1nm from ongoing offshore operations involving vessels restricted in their manoeuvrability. Therefore, these passing vessels are expected to increase their clearance to the south. There is available sea room for this action (Anatec 2018).

5.2.2 Mitigation measures

Table 5-5 presents mitigation measures that will be adopted in the Vorlich development.

Table 5-5 Mitigation measures – physical presence

ID	Mitigation measures
M1	Project vessels will follow the International Maritime Organisation (IMO) Regulations to reduce the likelihood of collision i.e. shall comply with Standard Marking Schedule. This includes requirements for navigation, lighting, obstruction lighting and beacons.
M2	Users of the sea will be notified of the presence and intended movements of the project vessels via the Kingfisher Fortnightly Bulletins, Notices to Mariners, Notice to Lighthouse Board, and very high frequency (VHF) radio broadcasts.

5.2.3 Residual impact

The area is of low importance to commercial fisheries when compared with the surrounding ICES rectangles, therefore commercial fisheries are not expected to be impacted.

A proportion of vessels on the six routes which pass within 10nm of the development may be affected by the operation. However, there is sea room available surrounding the development area for transiting vessels to safely increase their passing distances from the short-duration installation activities.

It has been assessed that there will be no residual impacts from the activities.

5.3 Generation of atmospheric emissions

5.3.1 Impact assessment

This assessment concluded that the risk posed to the environment by the generation of atmosphere emissions is acceptable.

Table 5-6 presents the estimated gas emissions arising from operations at Vorlich. As discussed in Chapter 3, emissions will arise from drilling, pipeline installation, flaring. Calculations use the emission factors recommended under the environmental emissions monitoring system (EEMS 2008), updated in DECC guidance (DECC 2015).

5.3.1.1 Air quality

Air quality, as measured by concentrations of gases with the potential to cause environmental or human harm, other than through contribution to climate change i.e. carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxides (NO_x), nitrous oxide (N_2O), sulphur oxides (SO_x), methane (CH_4), and volatile organic compounds (VOC), is not considered an issue offshore, as there are no proximate receptors.

Global warming potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere; usually expressed as CO_2 equivalent (CO_2-e). Greenhouse gases differ in their abilities to trap heat. Carbon dioxide is the dominant greenhouse gas and is therefore used as a reference (GWP value of 1) against which other gases are compared. The conversion factors used in Table 5-6 below to calculate CO_2-e are as given in Defra (2015).

Table 5-6 estimates that during field development (drilling, pipeline installation and one flaring event) approximately 67984 tonnes CO_2-e will be released. This decreases to 33242 tonnes per annum CO_2-e once the field is producing. This scale of emissions represents a very small portion of UK greenhouse gas emissions (currently anticipated to average 463 million tonnes CO_2-e per year over the period 2018 to 2027 (DECC 2015)). Such emissions are an aspect of offshore oil and gas operations.

There has been a general decline in offshore emissions of carbon dioxide from the oil and gas industry since 2000. Factors such as a decline in production and produced water volumes over this period have been influential in reducing emissions by reducing the load on diesel generators (OGUK 2015). EEMS data on offshore emissions from mobile installations, for 2011[1], show that 30 mobile drilling rigs were mobilised in UK waters; either drilling or conducting workovers on 91 wells (OGUK 2011). The rigs emitted: 251,656 tonnes of CO_2; 16.9 tonnes of N_2O; and 25.5 tonnes of CH_4; a global warming potential of 0.26 million tonnes of CO_2 equivalent emissions over the year. Rig emissions during the proposed drilling operation (2 wells) would represent approximately 4.6% of this figure, indicating that it will be a minor contributor to the total UKCS rig emissions.

There may be an incremental increase in flaring on the FPF-1 following the Vorlich tie-in. This will be reviewed within the asset flare permits in future once steady performance data is available.

Production from the Vorlich field will result in an incremental increase in air emissions from the host platform when in operation, however as Vorlich will be replacing ullage these emissions will be required to be included in the host Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2001 as amended by the Offshore Combustion Installations (Prevention and Control of Pollution) 2007 (the “PPC Regulations”). No additional power requirements are necessary to support Vorlich production.

[1] 2011 provides the most up to date information for UK drilling rig emissions which provides values broken down into greenhouse gas emissions.

Table 5-6 Air emissions

Aspect		Fuel Use (t/d)	Days	Total Fuel Use (t)	Emissions (t)							
					CO_2	CO	NO_x	N_2O	SO_x	CH_4	VOC	CO_2-e
GWP Values					**1**			**298**		**25**		
Drilling (per well, based on 102 day operation)												
Drilling rig		18	102	1836	5875	28.8	108	0.40	1.84	0.33	3.67	6004
Standby Vessel		5	102	510	1632	8.0	30	0.11	0.51	0.09	1.02	1668
Supply Vessels		5	25.5	128	408	2.0	8	0.03	0.13	0.02	0.26	417
Helicopters		1.1	102	113	361	0.6	1	0.02	0.23	0.01	0.09	369
Total		-	-	-	**8276**	**39.4**	**147**	**0.56**	**2.71**	**0.45**	**5.04**	**8458**
Total for 2 wells		-	-	-	**16552**	**78.8**	**294**	**1.12**	**5.42**	**0.9**	**10.08**	**16916**
Pipeline Installation, Tie-in and commissioning												
Pipelay vessel		5	10	50	160	0.8	3	0.01	0.05	0.01	0.10	164
Survey vessel		5	3	15	48	0.2	1	0.00	0.02	0.00	0.03	49
Trenching/backfilling vessel		5	14	70	224	1.1	4	0.02	0.07	0.01	0.14	229
Support vessel		5	29	145	464	2.3	9	0.03	0.15	0.03	0.29	474
Total		-	-	-	**896**	**4.4**	**17**	**0.06**	**0.29**	**0.05**	**0.56**	**916**
Flaring (1 event per annum over 10-year field life)												
1 event	Oil	1572	4	6288	20122	113	23	0.51	0.08	157.2	157.2	33242
	Gas	690	4	2761	7730	18.5	3	0.22	0.04	49.69	5.52	
Flaring over 10-year field life	Oil	1572	40	62880	201216	1132	233	5.09	0.8	1572	1572	332420
	Gas	690	40	27606	77297	185	33	2.24	0.35	496.9	55.2	
Total		-	-	-	278513	1317	266	7.33	1.15	2068.9	1627.2	**332420**

5.3.2 Mitigation measures

Table 5-7 presents the mitigation measures that will be adopted in the Vorlich development.

Table 5-7 Mitigation measures – atmospheric emissions

ID	Mitigation measures
M3	BP and Vorlich partners will undertake practical steps, such as ensuring efficient operations, keeping power generation equipment well maintained and monitoring fuel consumption, to minimise atmospheric emissions.
M4	All vessels employed during drilling activities will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, which controls the levels of pollutants entering the atmosphere.
M5	Inspection and maintenance programmes will be used in line with the requirements of indicative BAT to ensure that power generation equipment is kept and operated in a manner to optimise efficiency and minimise fuel consumption.
M6	BP and Vorlich partners will be required to review BAT assessments as part of the application for permission to vent and flare associated with the drilling/ FPF-1 installation. These assessments and the subsequent permits will ensure that greenhouse gas emissions are kept to the minimum consistent with operational requirements for maintaining the development.

5.3.3 Residual impact

It has been assessed that there will be no residual impacts from the activities.

5.4 Generation of underwater noise

5.4.1 Impact assessment

This assessment concluded that the risk posed to the environment by the generation of underwater noise is acceptable.

The main environmental receptors potentially impacted by underwater noise are plankton (including fish eggs and larvae), adult fish and marine mammals. Underwater noise has the potential to modify behavioural patterns (e.g., causing avoidance behaviour) and in certain situations the pressure waves associated with the noise may cause physical injury and even death.

It is an offence under The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2011 and the Offshore Marine Conservation (Natural Habitats &c) (Amendment) Regulations 2012, to deliberately capture, injure, kill or disturb any wild animal of an EPS. Disturbance of animals includes any disturbance which is likely:

a) To impair their ability –

i) To survive, to breed or reproduce, or to rear or nurture their young; or

ii) In the case of animals of a hibernating or migratory species, to hibernate or migrate; or

b) To affect significantly the local distribution or abundance of the species to which they belong.

All cetacean species are EPS and therefore causing injury or disturbance could be considered an offence.

5.4.1.1 Sound Levels

The main sound sources during operations at Vorlich will originate from machinery noise (e.g. drilling activities and use of thrusters on pipelay vessels) and the piling of the manifold.

Machinery noise

Machinery noise generation is generally considered to be of relatively low intensity and near continuous, although some events will result in short term peaks in intensity. Most of the noise generated by offshore oil installations, is low frequency (<1kHz) and drilling activities have been shown to produce noise similar to that of a large merchant vessel (Genesis Oil and Gas Consultants 2011a).

The Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), previously the Department of Energy and Climate Change, commissioned a review in 2011 looking at underwater sound produced from oil and gas activities. The review provides measurements taken from a semi-submersible rig whilst active, not drilling and drilling. Source levels recorded were 117dB (rms) re 1µPa@1m and 115dB (rms) re 1µPa@1m respectively, in low frequencies <70Hz (Genesis Oil and Gas Consultants 2011a).

Source levels expected from a dynamically positioned pipelay vessel are likely to have a SPL of 178dB re: 1µPa @1m (rms) and a frequency of 100Hz (Wyatt 2008). The pipelay vessel will travel between the VDC and FPF-1, therefore noise emitted during pipeline installation will generally be transient and temporary.

Piling

The setting of the manifold has the potential to cause significant underwater noise. As described in Section 3.4.2.1, the manifold will be anchored in position using four piles. Each pile is anticipated to be 610mm in diameter and 28m long. It is expected that piling will take one hour per pile. Total penetration depth is 21m.

In the absence of operational specific data, it has been assumed that the manifold will be put in place by impact pile driving. Pile driving activities generate predominantly low frequency sound within the range 100-400Hz, although some tones above 1kHz are also produced (Genesis Oil and Gas Consultants 2011a). The noise levels associated with piling depend on factors such as pile material, water depth and pile driving method. The expected sound pressure levels (SPL) produced can be estimated using the following formulae:

- SPL (peak to peak) = 230.25 * $D^{0.0774}$ (Wyatt 2008).
- SPL (peak to peak) = 24.3D + 179 (Nedwell *et al.* 2005).

Using a pile diameter D of 0.61m, these equations estimate SPLs (peak to peak) of 222dB re:1µPa and 194dB re:1µPa respectively. These values correspond to SPL (zero to peak) values of approximately 216dB re:1µPa@1m and 188dB re:1µPa@1m. The frequency for the piling of the manifold at Vorlich has been assumed to be 100Hz.

5.4.1.2 Noise assessment

Sound attenuates as it propagates through water and the local oceanographic conditions will affect both the path of the sound into the water column and how much sound is transmitted. Attenuation can be calculated using the equation SPL = SL – 15log (R). In this equation SPL = sound pressure level, R is the distance from a source level (SL) and 15 is attenuation value associated with spreading (MMO 2015).

The assessment considers the likely noise levels associated with the proposed operations and using the equation above calculates the distance from the source that noise levels will diminish to below the Southall *et al.* (2007) injury criteria (as discussed below).

As the piling of the manifold will produce sound levels greater than those produced by routine drilling operations, the piling has been modelled as the worst case for potential impact on marine life. Noise emission from the pipelay vessels has also been assessed.

5.4.1.3 Plankton, fish and shellfish

The risk to plankton and fish, posed by subsea noise and vibration generated during the proposed operation, is assessed as acceptable. The guidance and much of the research regarding the impacts of subsea noise on fish relates to seismic sources used during site investigations. Smaller larval fish and eggs are unable to move aside from disturbance and those near to a large sound source will be unavoidably damaged. As the water column refreshes and brings more juveniles and eggs into the vicinity a fresh sample may be damaged. Studies on the impacts of subsea noise on juvenile fish during seismic surveys (Gausland 2003) show that the numbers affected are generally small. Impacts, reported in Curtin University's 2017 media release (Curtin University 2017), can be observed out to 1.2km from source. The noise generated from piling is a lot lower in intensity and is of different frequency and is therefore expected to have a much lower impact. In addition, the plankton community undergoes a continual change in individuals with those from the surrounding waters and therefore have extremely rapid recovery rates. It is not expected that the noise levels generated will be high enough to damage population structures.

Research indicates that adult fish generally demonstrate temporary avoidance by swimming away from air guns (Gausland 2003). Additionally anecdotal evidence from ROV footage during drilling operations shows fish are present around wellhead when drilling. Therefore, given piling and pipeline installation generate noise of lower intensity than air guns, adult fish are not expected to be adversely affected by noise generated during drilling activities.

5.4.1.4 Marine mammals

The risks to marine mammals from anthropogenic noise and vibration are well documented (e.g. DECC 2016). Both cetaceans and pinnipeds have evolved to use sound as an important aid in navigation, communication and hunting (Richardson *et al.* 1995). It is generally accepted that exposure to anthropogenic sound can induce a range of effects on marine mammals. These range insignificant impacts (behavioural changes and non-injurious type effects) to significant impacts including permanent hearing damage. Insignificant impacts may include masking of biologically relevant sound signals such as communication signals. Such effects may produce a temporary reduction in hearing sensitivity which is reversible.

Activities with a high SPL, where the threshold of hearing is permanently damaged, may cause social isolation and the inability to locate food. These impacts are of particular concern (Southall *et al*. 2007).

An animal's ability to detect sounds produced by anthropogenic activities depends on the amount of natural ambient or background sound. Wind, precipitation, vessel traffic, and biological sources all contribute to ambient sound. All noise produced by anthropogenic activities greater than 20 - 30dB above background noise is considered to have the potential for disturbance to sensitive marine mammals (Cato 2009).

Noise generated by the development falls into two categories:

- Impulsive noise e.g. piling; and
- Continuous noise e.g. pipeline trenching, rock or mattress placement, vessels using dynamic positioning and support vessels.

<u>Impulsive noise</u>

The JNCC currently recommends the use of the Southall *et al.* (2007) criteria for impact assessment. Southall *et al.* (2007) separate marine mammals into five groups based on their functional hearing, namely: low-frequency cetaceans; mid frequency cetaceans; high frequency cetaceans; pinnipeds in water; and pinnipeds in air. For each group thresholds at which a permanent threshold shift (PTS) and a temporary threshold shift (TTS) in hearing are thought to occur have been defined. These thresholds are used to represent injurious effects.

The potential for disturbance is calculated using the same approach as injury. ASCOBANS (2011) suggest that a threshold value of 140dB re. 1µPa (peak) is a reasonable level at which to assume disturbance effects can be expected in harbour porpoise within European waters. A threshold of 145dB re. 1µPa (peak) is used for pinnipeds in water based on research in Kastelein (2011).

These thresholds and the distances at which it has been calculated they could be exceeded during the impact piling of the manifold, are shown in Table 5-8.

Table 5-8 Noise modelling results, piling (216dB$_{0-peak}$ re:1µPa@1m)

Auditory Group	Species present in development area	Threshold SPL: dB re: 1µPa@1m (0 - peak)		Distance from Source (km) where threshold is exceeded
Low frequency cetacean	Minke whale	PTS	230[1]	Threshold not exceeded
		TTS	224[1]	Threshold not exceeded
		Disturbance	224[1]	Threshold not exceeded
Mid frequency cetacean	Atlantic white-beaked dolphin and Atlantic white-sided dolphin	PTS	230[1]	Threshold not exceeded
		TTS	224[1]	Threshold not exceeded
		Disturbance	224[1]	Threshold not exceeded
High frequency cetacean	Harbour porpoise	PTS	230[1]	Threshold not exceeded
		TTS	224[1]	Threshold not exceeded
		Disturbance	140[2]	120
Pinnipeds in water	Grey seal & harbour seal are unlikely to be present.	PTS	218[1]	Threshold not exceeded
		TTS	214[1]	Threshold not exceeded
		Disturbance	145[3]	54

Source of threshold values:

[1] Southall et al. (2007) provides the same threshold for TTS and disturbance for pinnipeds and cetaceans

[2] ASCOBANS (2011)

[3] Kastelein (2011)

As discussed in Section 3, the piling of the manifold will take one hour per pile (four hours in total). The activity is currently planned for April 2020. Minke whale is the only cetacean likely to be present (in low densities) during April.

The results of the noise assessment, presented in Table 5-8 above, indicate that both cetaceans and pinnipeds are unlikely to be injured (PTS or TTS) as the threshold value is not exceeded.

Calculations indicate that harbour porpoises and pinnipeds could show a reaction at distances up to 120km and 54km respectively. This is a conservative estimate as it does not account for the increased attenuation of high frequency sound in water (Spiga 2015); seabed interactions; seabed type; change in salinity, bathymetry, temperature or density; and level of existing background noise, which would reduce the zone of ensonification. In addition, the piling of the manifold will be of extremely short duration (one hour) and Section 4.4.5 suggests that these species are not expected to be present within the development area during the period of piling. The closest protected site designated to protect harbour porpoise, the Southern North Sea cSAC, lies 161km to the south. Recent studies indicate that harbour porpoise are located predominantly in the south of the site (off East Anglia and the Thames Estuary) during the winter months (JNCC 2016), moving to the north of the site during summer. This suggests that although piling could potentially disturb harbour porpoise over a significant area, harbour porpoise are likely to be using more southerly waters during the piling activity, outside the range of influence. It is unlikely that significant numbers of animals will be present in the area effected by the underwater noise changes to effect the conservation objectives for the species.

In an analysis of the impacts of pile driving activities, Tougaard *et al.* (2014) suggest that pile driving may cause harbour porpoises to be displaced from an area of radius up to 26km, termed the effective deterrence radius (EDR), from the source. The report is specifically related to pile driving associated with wind farms, which routinely employ 4 to 6.5m diameter piles. The report concludes that wind farm construction may have small but measurable population-level effects on harbour porpoise, but that these are almost certainly less significant than those related to other human and natural factors and are unlikely to affect the long-term viability of this species in the North Sea.

The development area is located 241km from the Scottish coastline. Densities data from Jones *et al.* (2015) suggest that the area is not within a grey or harbour seal foraging area. It is therefore unlikely that pinnipeds will be affected by the piling.

Continuous noise

Pipeline installation, maintenance activities and vessel noise typically create continuous noise characterised by low levels of sound spread over a longer period of time, typically many seconds, minutes or even hours. The amplitude of the sound may vary throughout the duration, but the amplitude does not fall to zero for any significant time. The metric generally applied to continuous sounds is sound pressure level (SPL). SPL is time averaged and most commonly expressed as a root mean square (RMS) value.

For continuous noise, the source levels available for a pipelay vessel are sound pressure levels (rms). The sound pressure levels from drilling and pipeline lay vessels discussed above are below the threshold for injury and therefore animals will not be physically harmed from these activities. During installation no injuries from continuous underwater noise are anticipated.

The US National Marine Fisheries Service guidance (Battelle 2005) sets a 'Level B harassment' threshold for cetacean (where exposure is estimated to result in a 50% behavioural avoidance for each species or group of species) at 120dB re 1µPa (rms) for continuous noise. In the absence of other comparable metric thresholds, this value has been used to predict the onset of behavioural reaction for continuous noise.

Threshold levels for pinniped disturbance are expressed as sound exposure levels (145dB re 1 $\mu Pa^2 s$ (Kastelein *et al*. 2011; Kastelein *et al*. 2013a and b; TNO 2015). This disturbance threshold level has been converted to reflect SPL (rms) by the addition of 9dB to the SEL (TNO 2015). It is possible that conversion from SEL to SPL will introduce errors however, no other threshold level in SPL for pinniped are known. Given the variability in animals' auditory capacity and the variable nature of background sound, the assessment is an indication of the worst case and is unlikely to reflect received levels of sound by cetacean in the environment.

Using the same method as for injury, the attenuation of source levels using the worst-case frequency produced by pipelay vessels was calculated and compared against the referenced disturbance thresholds.

Table 5-9 Noise modelling results, pipelay vessel (178 dB_{rms} re 1µPa@1m; frequency 100Hz)

Auditory Group	Species present in development area	Disturbance Threshold SPL: dB re: 1µPa@1m (rms)	Distance from Source (km) where threshold is exceeded
Low frequency cetacean	Minke whale	120	7.5
Mid frequency cetacean	Atlantic white-beaked dolphin and Atlantic white-sided dolphin	120	7.5

Auditory Group	Species present in development area	Disturbance Threshold SPL: dB re: 1µPa@1m (rms)	Distance from Source (km) where threshold is exceeded
High frequency cetacean	Harbour porpoise	120	7.5
Pinnipeds in water	Grey seal & harbour seal are unlikely to be present.	145	0.17

The conservative assessment results for disturbance from continuous noise indicates that the pipelay vessel may disturb cetaceans within 7.5km and pinnipeds within 0.17km of the activity. However, this does not take in to account the level of background noise within the region, and sound is likely to be well below the disturbance threshold much closer to the source.

Data from Reid *et al.* (2003) harbour porpoise may be present in only low densities toward the end of the pipelay window. The development area is located 241km from the Scottish coastline. Densities data from Jones *et al.* (2015) suggest that the area is not within a grey or harbour seal foraging area. It is therefore unlikely that significant numbers of harbour porpoise or pinnipeds will be affected by pipelay activities to affect the conservation objectives for the species.

5.4.1.5 Protected sites

All protected sites designated for EPA are greater than 100km from the development area. It is noted that animals are highly mobile and will range outside of their site that, however the assessment conducted above identified no significant effect.

5.4.2 Mitigation measures

Table 5-9 presents mitigation measures that will be adopted in the Vorlich development.

Table 5-10 Mitigation measures – underwater noise

ID	Mitigation measures
M7	A dedicated Marine Mammal Observers will conduct visual surveys during piling activities within hours of daylight.
M8	The JNCC protocol for minimising the risk of injury to marine mammals from piling noise will be followed. This includes: ▪ Slow start up i.e., gradual ramping up of power, will be used during piling to ensure that any mammals will have sufficient time to leave the area. The soft start up duration will not be less than 20 minutes. ▪ Dedicated MMOs will be on board for the duration of the piling. If a marine mammal is detected within 500m of the operational site during the soft start, then, if possible, the setting of the manifold will cease or at the least the power will not be ramped up further until the marine mammal has left the zone and there has been no further detection for at least 20 minutes. ▪ If there is a break in the driving operations for a period of greater than 20 minutes a soft start procedure will be repeated.

No mitigation is proposed for noise generated by machinery and vessels.

5.4.3 Residual impact

As PTS and TTS thresholds are not exceeded by the piling activities there will be no risk of injury to cetaceans or pinnipeds. Harbour porpoise, grey and common seals which are susceptible to disturbance within 1.7km of the sound are unlikely to be in the area (Section 4.4.5) at the time of piling as operations are planned to be conducted in April. With this considered and with mitigation measures in place, the EIA concluded that the risk of a residual impact is acceptable.

5.5 Marine discharges

5.5.1 Impact assessment

This assessment concluded that the risk posed to the marine environment by marine discharges during the operation is acceptable.

There is no anticipated additional produced water discharges from the FPF-1 as a consequence of the development.

The safe drilling and completion of a well requires a large number of chemicals, with quantities of some chemicals exceeding 100 tonnes. Chemical discharges will occur throughout the drilling campaigns which are anticipated to take up to 102 days per well. Chemical discharges associated with pipeline installation are of relatively short duration (few days) with a smaller number and quantity of chemicals discharged (typically in quantities in the range of tens of tonnes). Therefore, drilling discharges typically represent the higher risk to the environment.

The estimated (indicative) worst-case drilling discharges are referred to in Section 5.6.1. All proposed discharges must be risk assessed as part of the chemical permitting process ahead of activities commencing, and will be subject to the conditions set in the approved permit.

The discharge of chemicals in to the marine environment has the potential for toxic effects on water column and benthic species and may in some very severe cases contaminate seabed sediments.

Water column species are only likely to be vulnerable within a short distance of any discharge, as chemicals will be rapidly diluted to below potentially toxic concentrations under the energetic conditions prevalent in the UKCS. Therefore, no significant impact is anticipated at population level.

Benthic fauna are potentially vulnerable to discharges which will enter the sediment (seabed discharges) as they may be unable to move or drift away from discharges.

The tidal current speeds in the region, range from 0.34 to 0.43ms^{-1}, therefore any discharges are likely to be rapidly diluted and dispersed and any harmful effects will be highly localised. Where potentially toxic chemicals are used their impact is largely mitigated either by the small quantities in which they are applied or because pathway from source-to-receptor is extremely limited. Impacts on water quality are expected to be short term and localised. This aligns with the findings published from an impact study for drilling which stated that a 1,000-fold dilution is expected within 10 minutes of discharge (Genesis Oil and Gas Consultants 2011b). The environment will generally be able to rapidly assimilate the discharges and deal with them through natural bacterial action. Therefore, the risk posed by operations to protected sites and species has been assessed as acceptable.

The potential impacts of a hydrocarbon discharge during drilling and pipeline installation operations at Vorlich are discussed in Section 6.

5.5.2 Mitigation measures

Table 5-10 presents mitigation measures that will be adopted in the Vorlich development:

Table 5-11 Mitigation measures – marine discharges

ID	Mitigation measures
M9	Chemical use and discharge will be regularly reviewed and kept to the minimum consistent with operational requirements.
M10	Where suitable alternatives are available and deemed fit for purpose, chemicals with lower potential for environmental impact will be reviewed.
M11	Chemical storage and usage is in accordance with the vessel's COSHH procedure and Material Safety Data Sheets are carried for all hazardous substances.

5.5.3 Residual impact

It has been assessed that there will be no residual impacts from the activities.

5.6 Seabed footprint

5.6.1 Quantification of footprint

It is important to quantify the seabed footprint of development activities to determine the extent of the impact on seabed habitats in the area. A seabed footprint will result from anchoring associated with the semi-submersible rig, drill cuttings deposition and pipeline installation and protection, as discussed below.

5.6.1.1 Semi-submersible rig

It is expected that the semi-submersible will use dynamic positioning to remain on-station at the two wells, with no associated seabed footprint. Anchors are considered as a contingency and have been included in the estimation of the worst-case seabed footprint.

As the exact rig to be used is not known, anchoring footprint information from the Deepsea Aberdeen has been used to inform this assessment. If required, it is estimated that the rig will use eight 18 tonne anchors to maintain its position over the well location. Each anchor has an estimated footprint of 45m^2. This equates to 364m^2 for all eight anchors. Anchor chains provide additional anchoring hold, but also create gouges and scar marks as the chains move under wind and tidal influence. This could potentially affect an area of approximately 112,000m^2 (each chain affecting an area of approximately 1,400m x 10m), as assumed in the Quad 204 ES (BP 2010). This is the worst-case anchor chain footprint, as it includes a 5m lateral motion either side of its position during storm events, when the drilling rig is floating in the swell (BP 2010). When anchors are lifted clear the anchor flukes lever sediment onto the seabed creating both a mound and a pull-out depression (an area of disturbed seabed). The size of the mound and depressions is dependent on the seabed characteristics and local hydrography and are common where surface or shallow sub-surface sediments are composed of clay. As identified within the 2017 development area survey (Fugro 2017), sediments near the VDC consist of sands and silts. Such sediment is less cohesive than clay and therefore less conducive to creating anchor mounds.

5.6.1.2 Drill cuttings

Table 5-11 details the quantity of drill cuttings likely to be generated by each well and their fate. Discharge at the seabed occurs when there is no way to contain and return the WBM and cuttings to the surface. Cuttings contaminated with OBM will not be discharged to the marine environment.

Table 5-12 Expected drill cutting quantities

Section Diameter (inches)	Section Length (m)	Volume of Cuttings (m^3)	Weight of Cuttings (tonnes)	Type of mud	Fate of cuttings
36"	310	290	580	WBM	Discharged at the seabed
26"	600	274	575	WBM	Discharged at the seabed
17½"	800	146	322	WBM	Discharged at the surface
12¼"	1400	120	288	OBM	Skipped and shipped to shore
8½"	300	12	30	OBM	Skipped and shipped to shore
Total per well	**3410**	**842**	**1794**		
Total for well 1 and well 2 combined	**6819**	**1684**	**3588**		

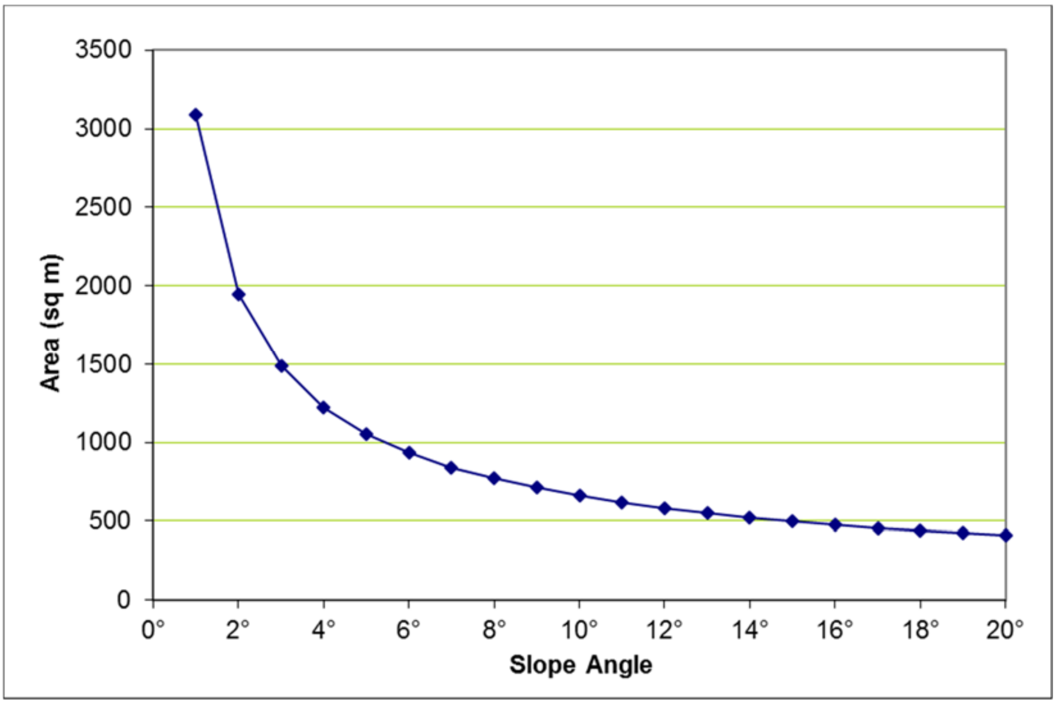
Note: Section lengths are based on the estimated well design, however this is subject to change.

The cuttings and associated WBM discharged at the seabed will form a pile around the well head. Under conditions of low current speed it is assumed that the cuttings pile would form in the shape of a cone, with a slope angle of 18°[2]. Significant erosion to a cuttings pile takes place when seabed current speeds exceed $0.35ms^{-1}$ (UKOOA 2002) Section 4.2.1.4 states that current speeds in the CNS range between 0.34 to $0.43ms^{-1}$ during strong tidal currents and storm conditions in winter months. This suggests that erosion of the cuttings pile will take place during the first winter after drilling; although studies have shown that in the NNS cuttings piles can remain on the seabed for 5-10 years (DTI 2001; DECC 2009). In addition, as the associated WBM dissolves, the cuttings will lose cohesion and spread out. The most recent OSPAR publication found that undisturbed cuttings pile do not present a detectable environmental risk to the seabed (OSPAR 2009).

With the above in mind the extent of the cuttings pile, still assuming it will take the shape of a cone, has been calculated for a range of slope angles (see Figure 5-1). This represents the worst-case seabed footprint. Caluclations indicate that for a discharge of 1155 tonnes ($564m^3$) the cuttings pile is likely to have a maximum footprint on the seabed of $3{,}091m^2$. However, in reality, the footprint is likely to be less than the maximum due to cone formation (footnote 1) and would be $440m^2$ at a slope angle of 18°.

There is likely to be some overlap of drill cuttings piles, dependent on the juxtaposition of the two planned wells. However, for the sake of this assessment it has been assumed that a worst case combined drill cuttings footprint of $880m^2$ could be generated.

Figure 5-1 Extent of drill cuttings pile



Drill cuttings discharged just below the sea surface will be affected by the water depth and currents surrounding the drilling rig. As they consist of small particle sizes, deposition is likely to form a very thin deposit spread over a wide area (Neff 2005). Deposition is likely to be thickest nearest the deposition site thinning rapidly with distance.

[2] A height-to-radius ratio of 1:3; the cone will be six times wider than it is high. This assumes the sand particles to be smooth spheres and does not consider the cohesive effects of particle surface roughness, shape or chemicals (Jumars 2010).

5.6.1.3 Pipeline infrastructure

The seabed footprint of the pipeline installation at Vorlich will consist of the infrastructure and temporary and permanent deposits, as described in Section 3. The worst case footprint is shown in Table 5-12 below.

Table 5-13 Pipeline installation footprint

Element	Footprint (m^2)
Pipeline and umbilical	109,800
Manifold	140
Concrete mattresses	3,150
25kg grout bags	120
Rock placement (including contingency)	6,600
Total	**119,810**

5.6.1.4 Footprint summary

The seabed footprint of the development area will consist of the footprint of the infrastructure, drill cuttings, and temporary and permanent deposits, as summarised in Table 5-13 below.

Table 5-14 Seabed footprint summary

Aspect	Quantity	Seabed footprint (m^2)	Duration
2x production wells			
Anchoring from semi-sub rig	-	112,364	Temporary
Cuttings + mud	-	880	5-10 years
Infrastructure			
Pipeline and umbilical trenching	1	107,772	Temporary
Manifold	1	140	Permanent
Pipeline protection			
Concrete mattresses	175	3,150	Permanent
25kg grout bags	800	120	Permanent
Rock placement	15,000 (tonnes)	4,200	Permanent
Rock placement (mitigation)	10,000 (tonnes)	2,400	Permanent (contingency)
Total footprints			
Temporary	**112,364m^2**	Anchoring	
Permanent	**880m^2**	Drill cuttings 5- 10 years	
Permanent	**7610m^2**	Manifold and pipeline protection	
Permanent, contingency	**2,400m^2**	Pipeline protection	
Temporary	**107,772m^2**	Trenching	
Total	**123,254m^2**	Permanent (including contingency) and temporary	

Overall, it is anticipated that a maximum area of 220,136m^2 (0.22km^2) of seabed will be temporarily impacted by the proposed drilling and pipeline installation operations. In addition, 10,010m^2 (0.01km^2) is expected to be impacted permanently, however 2,400m^2 (0.002km^2) is included as a contingency for spot rock dumping at 30 discrete locations along the pipeline to mitigate against the risk of upheaval buckling.

5.6.2 Impact assessment

This assessment concluded that the risk posed to the marine environment by the seabed footprint of the development is acceptable.

5.6.2.1 Seabed sediments and features

Sediments in the development area are described as fine sand with patches of gravel and clay (Section 4.2.3.3). In addition, the development is 29km away from any protected sites designated for sediment habitats or features (see Section 4).

Deposits on the seabed will change the sediment character at the deposition sites as they replace the mobile sediment (sand and gravel) with immobile material. However, deposits will only alter a small area (0.01km^2) of this large-scale sediment type. Operations are not expected to change the regional sediment characteristics.

There may be an impact arising from re-suspension of fine sediments when the deposits are positioned. However, re-settled sediments will be the same as in the surrounding area and will not be thick enough to change the character of the sediment.

There is the potential for re-suspension of contaminated sediments. However, as discussed in Section 4.2.4.3, sediment contaminant levels are expected to be within the range of typical background levels. Therefore, proposed operations are not expected to have a significant impact on water quality or result in the redistribution of contaminated sediments.

5.6.2.2 Benthic fauna

The primary impact from seabed footprints is direct disturbance to the seabed resulting in the smothering and mortality of benthic fauna. The species identified in the area are typical of the region, consisting of a community predominantly dominated by polychaetes (Fugro 2017) (Section 4.4.1). The most vulnerable species to deposition of material are expected to be epifaunal species which are incapable of moving away from the disturbance. The epifaunal species observed in the development area included seapens and mobile crustacean species. Infaunal species are adapted to smothering and to some extent will be protected by overlying sediment. An increase in sediment suspension could impact suspension/filter/deposit feeders by interfering with food uptake, potentially affecting the growth and condition of these animals (Nicholls *et al.* 2003). However, sediments in the area are naturally mobile and benthic species that are present are unlikely to be sensitive to minor disturbances.

Temporary disturbance from trenching and anchoring:

Trenching and anchoring will physically disturb the benthic communities and their habitat within the vicinity of the activity and may cause some smothering in the wider area due to the re-deposition of excavated material. Trenching and anchoring will also result in the creation of a temporary plumes of suspended solids in the water column. It is likely that a high proportion of the benthic invertebrates within the width of the anchor and trench footprint, will be susceptible to mortality, injury or displacement as a result of coming into contact with trenching machinery, anchors and chains. This is more likely to affect sessile species such as sea pens and less mobile species such as echinoderms and polychaetes. Activities causing displacement and injury to infaunal species could also result in increased predation resulting from exposure of individuals. However, the benthic community within the development area is typical of the CNS, therefore numbers are likely to re-populate the affected area and populations will recover.

Ocean quahog within the immediate vicinity of trenching and anchoring will be susceptible to mortality. According to the MarLin sensitivity index, ocean quahog has a low resilience to physical change and has a high sensitivity. However, given the low numbers observed during the recent Fugro (2017) survey (Section 4.4.1) the temporary footprint resulting from trenching and anchoring is not expected to impact the wider population of this species.

Permanent loss of habitat (pipeline protection and manifold installation):

In areas where pipeline protection is required, the deposition of rock will result in the direct mortality of benthic species located beneath the footprint of the new material. It may also lead to long term, but localised changes to habitat characteristics, changing fine mobile sediments into hard substrate. It is expected that pipeline protection material is likely to be colonised by sessile epifaunal organisms from the surrounds, such as sponges, hydroids, bryozoans and soft corals, along with accompanying motile epifauna such as crustaceans and gastropod molluscs. As above it is not expected that pipeline protection will impact the wider population of ocean quahog.

Given that the manifold will only impact a 140m^2 area of seabed it is not expected to significantly impact benthic communities.

Permanent loss of habitat (deposition of drill cuttings):

In terms of recoverability following physical disturbance Jones *et al.* (2012) identifies that the timeframe of the recovery of benthic faunal communities following drilling operations is dependent on a complex interaction of factors. These include the duration and magnitude of impact, receiving community/species and the physical environment (i.e. currents and sediment type). Although these findings are the result of a study on deep-water megafaunal communities, this does provide some indication of how benthic communities within the development area may respond.

Jones *et al.* (2012) found that partial (mega) benthic recovery occurred between 3 and 10 years following an impact. Immediately after drilling and within the immediate vicinity of the drilling site, mobile faunal densities and richness were significantly decreased. This level of disturbance was largely restricted to within 100m of drilling activity, with disturbance barely measurable beyond 250m from the drilling site. In addition, after three years, sessile faunal density within 100m of the well had increased considerably and was no longer significantly different to conditions further away. Community compositions/biodiversity had not returned to its original state by this time. Megafaunal communities and deep-sea invertebrates are generally long-lived and recover more slowly than the shorter lived smaller infauna, which are prevalent within the development area. Faunal communities in the development area, as discussed in Section 4.4.1, are shorter-lived and therefore likely to have faster recoverability rates than those described by Jones *et al.* (2012) as they have. The acceptation of this is ocean quahog which can live up to 500 years and therefore will have a lower recovery rate. However, drill cuttings will only impact a small area of seabed (880m^2) and are therefore not expected to impact the wider population of this species.

A study by Neff (2005) concluded that potential impacts from WBM cuttings discharges were largely restricted to smothering. However, oxygen depletion could occur if cuttings contain a high concentration of biodegradable material. They further concluded that any impacts would be restricted to within approximately 150m of the discharge point.

In 2014 Oil and Gas UK commissioned Heriot-Watt University to undertake an assessment of benthic communities in areas affected by drilling operations. A total of 19 platforms in the UKCS were considered, 90% of which did not reveal any far field effects on the benthic data. The spatial extent of the impact footprint was greatest within the first one to two years after drilling, but in time the footprint shrank, in some cases to 50m. A study on the Norwegian Continental Shelf also found that the impacts of drill cuttings contaminated with WBM on benthic communities were restricted to 100-500m from the installation. Results from these studies show that impacts to benthic communities are generally confined to the immediate vicinity of the well and communities can recover (OGUK 2014).

5.6.2.3 Fish and shellfish

Immobile eggs, juveniles and shellfish present on the seabed around the wells and pipeline route will be subject to direct disturbance as they are likely to be smothered by drill cuttings, cable protection and trenching spoil.

Juveniles of spotted ray and spurdog are likely to use the seabed for nursing in the development area throughout the year. The loss or disturbance of habitat during operations will be localised (123,254m^2), representing only a very small footprint of the wider region, therefore there will be no impacts at population level.

Coull *et al.* (1998) has indicated, that Atlantic mackerel has a peak spawning period which could coincide with the drilling and/or pipeline installation schedule (Section 3 and 4), however Ellis *et al* (2012) have not confirmed the development area as a spawning ground for the species. The development area and surrounds is out with the area of high egg concentrations (Coull *et al.* 1998) or high intensity nursery grounds (Ellis *et al.* 2012). Atlantic mackerel are pelagic throughout their life cycle and will not be affected by the seabed footprint.

Finally, fish spawning or nursery grounds are large areas and the impact of operations are unlikely to affect any species on a population level.

5.6.2.4 Protected sites

The operation is located 29km east of the East of Gannet and Montrose Fields NCMPA, 29km north of the Fulmar MCZ and 70km east of a potential Annex I reef.

As deposits will be restricted to the immediate vicinity of the proposed pipeline route, and drill cuttings restricted to the immediate vicinity of the wells, it is unlikely that there will be any impact on the sites' protected features. The impacts from installation of infrastructure will be localised to the impact area and will disperse over time. Therefore, the impact assessment concluded that the potential impacts of the proposed operations on protected sites are acceptable.

There are no known pockmarks or other significant features, as discussed in Section 4, near the development area.

5.6.2.5 Commercial fisheries

The development area is in active fishing grounds targeting demersal species and shellfish. The development will increase the oil and gas footprint of the area; however the seabed footprint is not expected to impact the wider populations of fish species.

Drill cuttings pile will be restricted to the area surrounding the well head. As discussed in Section 5.6.2, the cuttings pile is likely to be eroded within 5-10 years and therefore the 500m exclusion zone around the VDC will prevent any impacts to fishing gear.

Drilling operations will be carried out within a designated 500m exclusion zone.

The seabed footprint created by the installation of the pipeline will be temporary. Trenching is expected to take up to 14 days to complete. The pipeline may be left in an open trench until the entire length is laid, or it will be backfilled as it is trenched. After backfill the final seabed profile will be a shallow depression over the pipelines due to the loss of finer sediments from displaced material through winnowing. This is not expected to impact commercial fisheries.

5.6.3 Mitigation measures

Table 5-16 presents mitigation measures that will be adopted in the Vorlich development.

Table 5-15 Mitigation measures – seabed footprint

ID	Mitigation measures
M12	Rock placement will only be employed where the integrity of the pipeline is at risk. Cover will be kept at the minimum required to ensure pipeline protection is adequate. Industry best practice shall be used when deploying rock dump.
M13	The manifold is designed to be a slab-sided fishing friendly structure with no snaggable protrusions.

5.6.4 Residual Impact

It has been assessed that there will be no residual impacts from the activities.

5.7 Susceptibility to natural disasters

The probability of a major natural disaster (such as an earthquake or tsunami) occurring in UK waters which could impact the development area is extremely low.

In the North Sea, the frequency of occurrence of a magnitude 4 natural seismic event is expected to be approximately every two years and that of a magnitude 5 event every 14 years. These events will not cause a natural disaster or likely to result in significant damage to offshore infrastructure.

In August 2015, a magnitude 4.1ML earthquake at a depth of 4km occurred in the Southern North Sea and was felt on nearby platforms and Sheringham on the Norfolk coast (DECC 2016). This event did not cause any damage to offshore oil and gas infrastructure.

5.7.1 Mitigation

Offshore structures are designed to withstand seismic forces and vibrations with little or no damage, whilst maintaining integrity without major collapse or loss of life. There is a reasonably low likelihood of exceedance during their lifetime.

6. UNPLANNED EVENTS

6.1 Introduction

It is possible that during the lifecycle of the Vorlich development an event may occur which results in unplanned releases to the environment. Possible types of unplanned releases include hydrocarbons; diesel (fuel); and chemicals e.g. drilling muds, drilling chemicals, pipeline chemicals etc.

Any unplanned release has the potential to impact the environment. However, the significance of the impact depends upon numerous factors including (but not limited to) the substance released, volume of release, toxicity, meteorological conditions at the time, and sensitivity of the receptors. Potentially at risk are receptors such as the water column (in terms of quality), water column and benthic species, seabirds, and in some very severe cases seabed sediments (i.e. potential for contamination).

The unplanned event scenarios discussed within this section are:

- Loss of primary containment resulting in chemical and/ or drilling fluid inventory release; and
- Loss of primary containment (well blow out scenario) resulting in hydrocarbon release.

6.2 Major Environmental Incident (MEI)

Some scenarios for unplanned events can have the potential to result in a major environmental incident (MEI), as defined in Offshore Safety Directive (EC Directive 2013/30/EU). Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations 2015 (SCR) Regulation 2 (SCR 2015 Reg. 2) defines a MEI as 'an incident which results, or is likely to result, in significant adverse effects on the environment in accordance with Directive 2004/35/EC of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage'.

The Environmental Liability Directive (EC Directive 2004/35/EC) defines environmental damage as:

"a) damage to protected species and natural habitats, which is any damage that has significant adverse effects on reaching or maintaining the favourable conservation status of such habitats or species. The significance of such effects is to be assessed with reference to the baseline condition;

b) water damage, which is any damage that significantly adversely affects the ecological, chemical and/or quantitative status and/or ecological potential, as defined in Directive 2000/60/EC [Water Framework Directive], *of the waters concerned; and*

c) land damage, which is any land contamination that creates a significant risk of human health being adversely affected as a result of the direct or indirect introduction, in, on or under land, of substances, preparations, organisms or micro-organisms."

The term 'damage' is defined as "*a measurable adverse change in a natural resource or measurable impairment of a natural resource service which may occur directly or indirectly*".

A MEI can only result if a major accident occurs. Major accidents that can result in a MEI are described as follows (as defined in SCR 2015 Reg. 2):

- An event involving a fire, explosion, loss of well control or the release of a dangerous substance causing, or with a significant potential to cause, death or serious personal injury to persons on the Installation or engaged in an activity on or in connection with it.
- An event involving major damage to the structure of the Installation or plant affixed to it or any loss in the stability of the Installation causing, or with a significant potential to cause, death or

serious personal injury to persons on the Installation or engaged in an activity on or in connection with it.

- Any other event arising from a work activity involving death or serious personal injury to five or more persons on the Installation or engaged in an activity on or in connection with it.

The flow rate at Vorlich is representative of the worst-case loss of containment and representative of a potential for an MEI as defined by the EIA Regulations and SCR 2015. MEI assessment will be completed as part of the development's safety case (SCR 2015 Reg.17 – safety case for production).

6.3 Unplanned releases

Five unplanned release scenarios are possible during the Vorlich development lifecycle as described in Table 6-1.

Table 6-1 Unplanned release scenarios

Scenarios	Description of the Unplanned release
1. Loss of well control/ well blow out	A well blowout scenario refers to an uncontrolled release of hydrocarbons as the result of a loss of well control. Hydrocarbons from the Vorlich reservoir are expected to be volatile oil. In the event of a loss of well control the worst-case flow rate is anticipated to be $14276.9m^3day^{-1}$ of gas condensate.
2. Semi-Submersible/ Pipelay vessel	Unplanned release of utility hydrocarbons (lube and hydraulic oils), fuel and/or OBM during bunkering or because of vessel impact or collision. Expected volumes of a total loss of diesel fuel/OBM could be significant but varies depending on the vessel/ drilling rig and associated inventories. The most likely worst-case scenario at Vorlich would be a loss of the total diesel and OBM inventory of the semi-submersible rig, particularly in the event of a major accident to the rig during drilling with OBM. The pipelay vessel is likely to have a smaller fuel inventory and will not carry significant quantities of chemicals.
3. Pipeline inventory or subsea release	Unplanned releases from pipelines may occur due to failure or accidental damage during installation, leak testing, commissioning or production operations. Minor releases such as ROV hydraulic releases are also possible. Within the subsea infrastructure, subsea safety isolation valve (SSIVs) reduce the total inventory that can be discharged during a line depressurisation event. ROV hydraulic inventories are limited and commonly releases associated with ROV operations are low volume.
4. Flare drop out/ release of hydrocarbons	Flare drop out may occur during well clean up. Flare drop out implies hydrocarbon drop out to the sea surface and can lead to the generation of surface sheens.
5. Unplanned release of chemicals	Unplanned release of chemical inventories, potentially resulting from a chemical storage tank release; release during bulk transfer/handling; pipeline subsea infrastructure or process release.

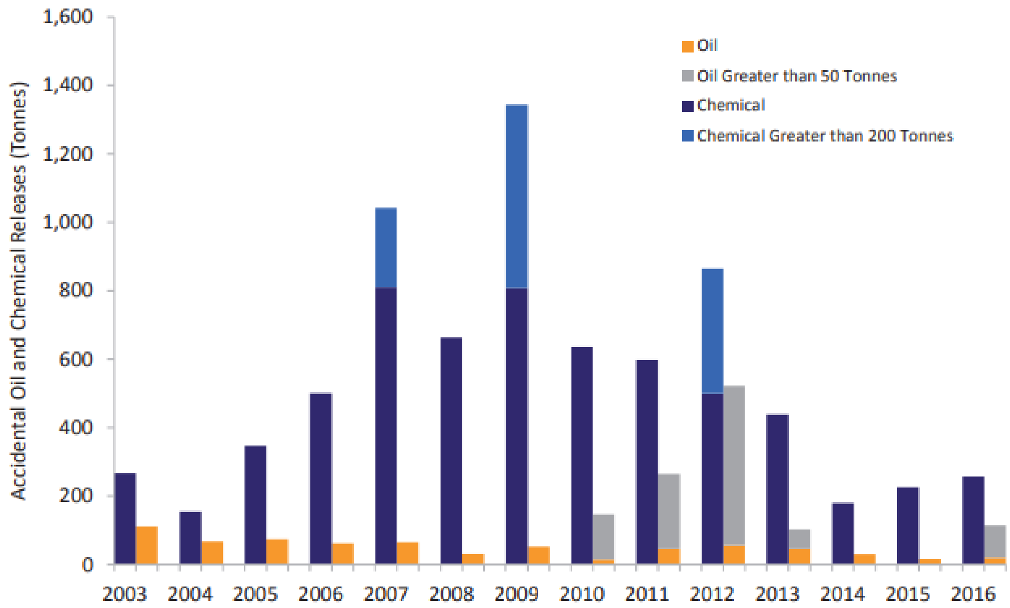
Of the scenarios described above, Scenario 1 (well-blow) represents the worst-case volumes of unplanned hydrocarbon release into the environment. This scenario has therefore been assessed within this Section. It is recognised that potential release volumes from Scenario 2 could also be significant, however, they are smaller (relatively) than in Scenario 1 and have not been assessed within this Section. They will be fully addressed in the drilling OPEP and/or FPF-1 OPEP which will be updated to include the Vorlich field.

6.3.2 Frequency of unplanned releases in the UKCS

The latest annual oil release data for the period 2003 to 2016 (OGUK 2017) indicates that discharges of >50 tonnes of oil are uncommon on the UKCS, with only one incident reported in 2016. No releases >200 tonnes were reported and there were eight releases greater than ten tonnes, in 2016. Between them, these incidents accounted for 83% and 66%, respectively, of the total oil and chemicals accidentally released in 2016. This is confirmed by release data from the period 2003 to 2016 (Figure

6-1) which indicates that in most years there were no incidents resulting in the release of more than 50 tonnes of oil, but in the five years when such incidents did occur they were responsible for most of oil released per annum.

Figure 6-1 Accidental chemical and oil release mass



Source: OGUK (2017)

During any offshore activity, there are also associated collision risks with other sea users that could lead to the event of a significant unplanned release. The vessel traffic survey undertaken for the Vorlich development (Section 4.5.2, Anatec 2018) estimated that 1,186 vessels per year pass within 10nm of the development area, corresponding to an average of approximately 3 to 4 vessels per day.

The Health & Safety Executive published a ship/platform collision incident database which provides collision frequency analysis for the period 1975 to 2001 (HSE 2003). It concludes that the frequency of a vessel colliding with a semi-submersible is 0.2379 incidents per year, reducing to 0 incidents per year if only 'passing vessels' are analysed. For all installations (fixed, semi-submersible & jack-ups) the frequency is 0.0987 incidents per year, reducing to 0.0014 incidents per year for passing vessels. This research indicates that the likelihood of a support vessel colliding with the drilling rig is low, reducing to very low for passing vessels.

6.3.3 Frequency of loss of well control scenario

A well blowout scenario refers to an uncontrolled release of hydrocarbons (reservoir fluids) into the environment because of a loss of well control; when the formation (reservoir) pressure exceeds the hydrostatic pressure of the mud or fluid column in the wellbore. Such events are rare due to the precautions taken to prevent a blowout scenario materialising.

Well blowout frequencies during drilling operations in the North Sea have been determined as low by OGP (2010), with the likelihood of a well blowout occurring at maximum flow rates for extended durations even more remote. The SINTEF database of blow-outs indicates that in the UK there have been 30 blow-outs between 1970 and 2007 but none of them have resulted in a pollution event (OGP 2010).

The associated risk to the environment from a well blowout scenario has been conducted through completion of oil release modelling. Assumptions/parameters used are based on a worst-case scenario determined from data currently available. These assumptions and the impact assessment are further described in Section 6.4 below.

6.4 Oil spill modelling

Modelling has been completed by Oil Spill Response Limited (OSRL) using SINTEF's Oil Spill Contingency and Response (OSCAR) model on behalf of BP. OSCAR is a 3D modelling tool used to predict movement and fate of oil on the sea surface and throughout the water column. The modelling results have been used to assess the potential environmental impacts from a worst-case well blowout scenario.

The modelling was performed to:

- Determine oil (condensate) trajectories;
- Determine dispersal data across sea surface and within the water column;
- Determine extent to which oil is likely to reach median line, shoreline and protected sites;
- Determine where concentration of oil could exceed certain thresholds within the water column; and
- Inform assessment of potential impacts.

6.4.1 Modelling scenarios

As discussed in Section 6.3, a well blowout scenario represents the worst-case release volume for the development and has been modelled for this EIA.

As the following unplanned hydrocarbon release scenarios, will have smaller (relatively) release volumes than a well blowout scenario they were not modelled.

- Unplanned release of diesel inventory from a vessel and/ or drilling rig; and
- Unplanned release of flowline inventory during operations.

The FPF-1 Installation OPEP will be updated to include Vorlich pipeline inventories (and determine any associated modelling requirements). An OPEP will be submitted for the drilling rig prior to operations commencing in line with the requirements of the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015.

6.4.2 Modelling parameters

The modelling parameters presented in Table 6-2 represent the worst-case scenario for a release from the VDC location.

Well design and planning are ongoing for the Vorlich development. Based on conservative assumptions and modelling conducted to date, a worst credible discharge has been calculated for oil spill modelling. As the well design statement progresses, any significant changes identified to this worst case credible discharge will be reviewed and modelling will be updated as necessary. Aligned with this, estimates have been taken from the FPF-1 OPEP (BEIS reference 16032) to use as basis for relief well drilling.

The modelling has been completed in line with the Department for Business, Energy and Industrial Strategy (BEIS) 'Guidance Notes for Preparing Oil Pollution Emergency Plans', dated October 2017.

Stochastic modelling has been conducted using the SINTEF OSCAR modelling package. In a stochastic simulation, a release trajectory is repeatedly run with a start date that is within the period covered by the available wind and/or hydrodynamic data:

- Representative wind data used in the model was taken from the UK Oil & Gas European Centre for Medium-Range Weather Forecasts (ECMWF).

- Representative current data was used in OSCAR, which is taken from predictions from the UK Oil & Gas Shelf daily currents.

For the selected worst-case scenario, 100 simulations were ran using a wind time series which started on a randomly selected date within the seasonal period covered. This approach allows a sufficient number of simulations to adequately model the variability in the wind speed and direction in the area identified within the simulation. Running multiple release simulations during a single season should provide a reliable prediction of the oil pathways and oiling probabilities for a release starting during that season and extending into subsequent seasons.

In alignment with the requirements as stipulated by BEIS Guidance, the results of the modelling were analysed to determine:

- The probability of a visible surface oil with a minimum thickness threshold of 0.3µm displayed to >10%;
- Time of arrival and probability >1% of crossing any UKCS median line;
- Time of arrival and probability >1% of shoreline contamination along the UK and adjacent coastlines respectively.

This report evaluates the scenario at the Vorlich field during all seasons: Winter (December-February); Spring (March- May); Summer (June-August); and Autumn (Sep-Nov).

Table 6-2 Modelling parameters

Well Loss Parameters								
Loss from Well/FPSO/Rig/Other	Well blowout	**Instantaneous loss?**	No					
Worst Case Volume	5,387,940 bbls	**Flow Rate**	89,799 bbls/day					
Justification for Predicted Worst Case Volume	Worst credible discharge rate throughout the time required to drill a relief well (60 days).							
Diameter of Release Hole	0.2168 m (8.535")	**Gas Density**	0.8 Kg/Sm^3					
Gas to oil Ratio	534,32.5m^3/m3	**Oil Temperature**	107.5 °C					
Location								
Spill Source Point	Latitude	56°52'03.92" N WGS84	**Longitude**	002°04'18.647" E WGS84				
Installation/Facility name	Vorlich Field	**Quad/Block**	30/1					
Hydrocarbon Properties								
Hydrocarbon name	Vorlich Condensate							
Assay Available	No	**Was an analogue used for oil spill modelling**	Yes					
	Name	**ITOPF category**	**Specific Gravity**	**API**	**Viscosity**	**Pour Point**	**Wax Content**	**Asphaltene Content**
Hydrocarbon	Vorlich Condensate	1	-	49.1	-	-51°C	4%	<0.05%
Analogue	Lavrans	1	0.789	47.8	2.0 cP	-6°C	6.0%	-
Metocean Parameters								
Air Temperature	2 - 15°C	**Sea Surface Temperature**	7 - 14°C					
Wind Data	**Data Period**	2012 – 2013 (2 years)						
Wind Data Reference	UK Oil & Gas (ECMWF)							
Current Data	**Data Period**	2012 – 2013 (2 years)						
Current Data Reference	UK Oil & Gas (Shelf daily currents)							
Temperature Profile	Source: Copernicus Marine Service Products GLOBAL_REANALYSIS_BIO_001_018							
Salinity Profile	Source: Copernicus Marine Service Products GLOBAL_REP_PHY_021							
Dissolved Oxygen Profile	Source: Copernicus Marine Service Products GLOBAL_REP_PHY_021							
Modelled release Parameters								
Surface or Subsurface	**Subsurface**	**Depth**	**90 m**					
Release Duration	60 days	Instantaneous	No					
Persistence Duration	10 days	Release Rate	89,799 bbls/day					
Total Simulation Time	70 days	Total Release	5,387,940 bbls					
Oil Spill Modelling Software & Setup								
	OSCAR	**Version**	**9.0.1**					
Surface Oil Threshold	0.0003mm	Time Step	30 minutes					
Water Column Threshold	58 ppb	Shoreline Oil Threshold	0.1 l/m^3					

6.4.3 Modelling outputs

The results indicate that a sustained release of 14276.9m^{3}day^{-1} of gas condensate has:

- 100% probability (all months) of crossing the UK/Norway median line in 15 hours;
- 97% probability (September-November) of crossing the Denmark/UK median line in 9 days, 12 hours;
- 81% probability (September-November) of crossing the Germany/UK median line in 12 days, 15 hours;
- 59% probability (September- November) of crossing the Netherlands/UK median line in 13 days, 6 hours; and
- 2% probability (March-May) of reaching the UK coastline (Northumberland).

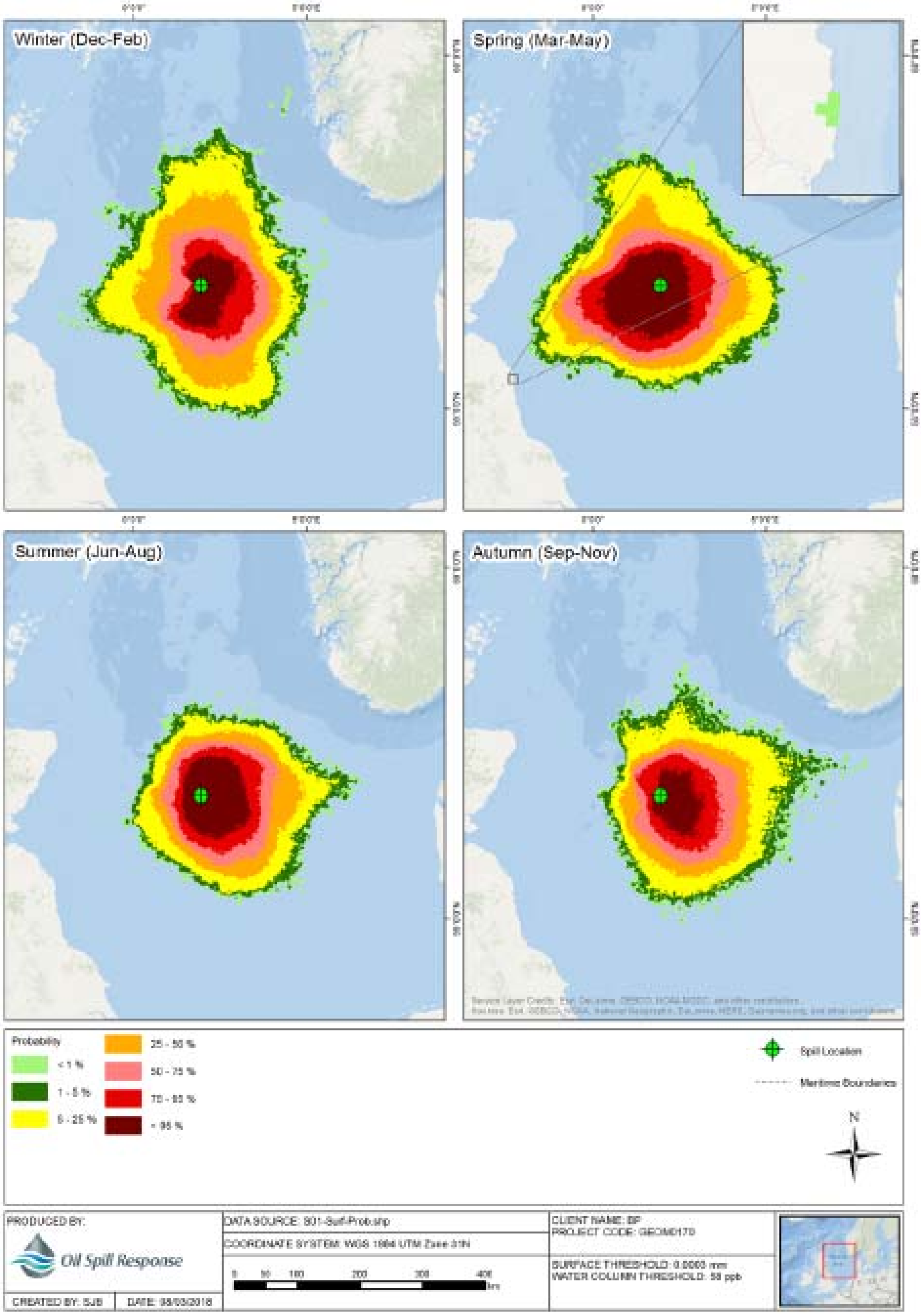
It is not thought likely that hydrocarbons would beach on any other North Sea shoreline.

The amount of UK shoreline oiling is estimated to be 31m^3 and would take approximately 56 days to reach the shore. It is estimated, that as a worst-case the release would cover an area of 46,942km^2 (March-May) before dispersal.

Figure 6-2 shows the probability of oil contaminating the sea surface and Figure 6-3 shows the minimum time for oil to arrive at the sea surface (BP 2018).

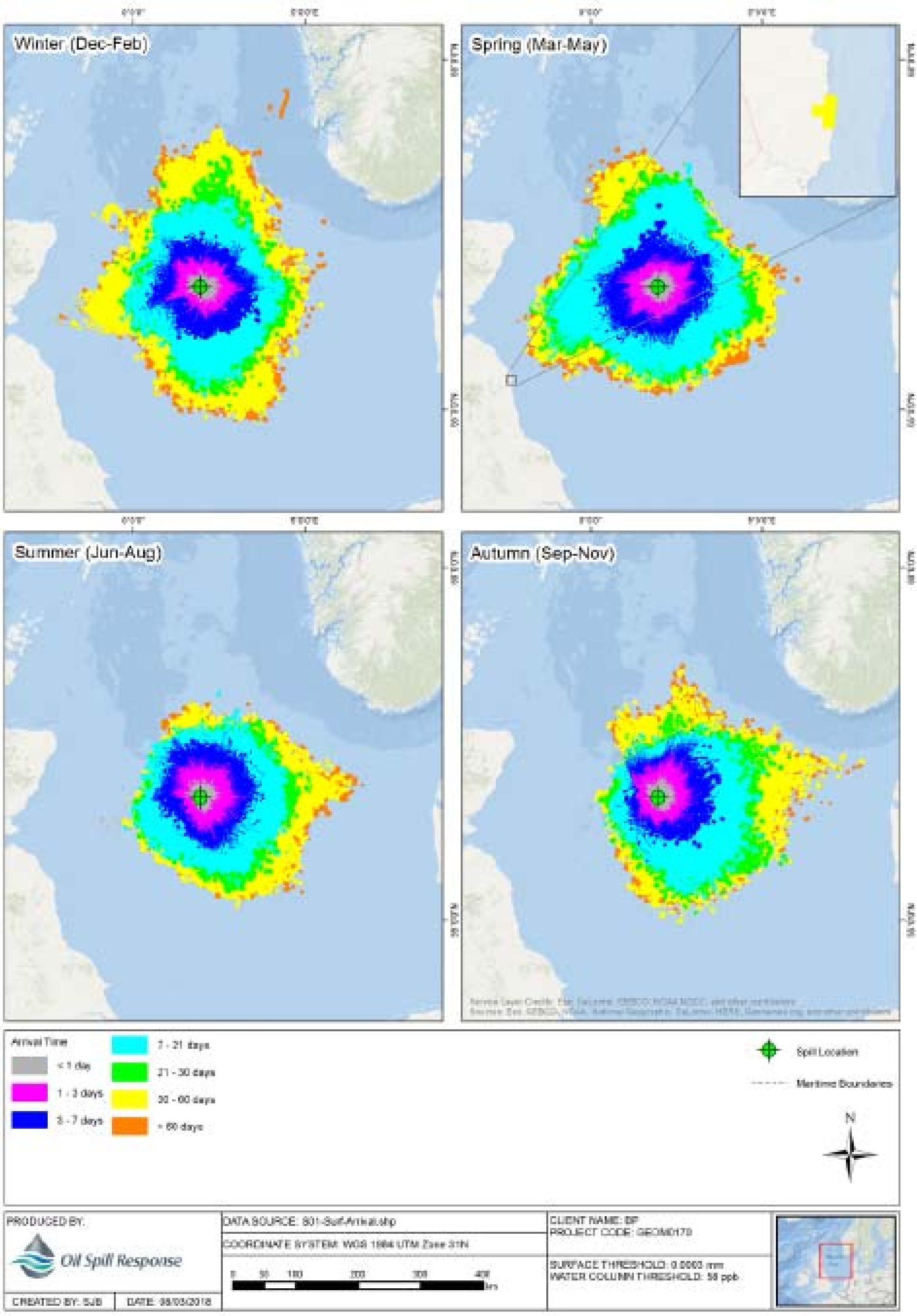
Figure 6-2 and Figure 6-3 indicate that the track and area of the release varies as a result of prevailing weather conditions. During summer and autumn months the release covers a smaller surface area (June – August - 35,695km^2, September-November 29,433km^2) than it does during winter and spring months (December – February 44,143km^{2,} March – May 46,942km^2). Table 6-1 shows the probability of impact to key protected sites and the minimal arrival times expected in the event of a hydrocarbon release. The Fulmar MCZ and East of Gannet and Montrose Fields NCMPA have been identified as having the greatest probability of being impacted.

Figure 6-2 Scenario 1 – probability of oil contaminating the sea surface (based on thickness of 0.3µm)



Source: BP (2018)

Figure 6-3 Scenario 1– minimum time for oil to arrive at the sea surface (based on thickness of 0.3µm)



Source: BP (2018)

Table 6-3 Key sensitivities at risk from a hydrocarbon release, probability and minimum arrival times

Site	Dec-Feb	Mar-May	Jun-Aug	Sep-Nov
Berwickshire and North Northumberland Coast SAC	-	<1%	-	-
	-	56 days 18 hrs	-	-

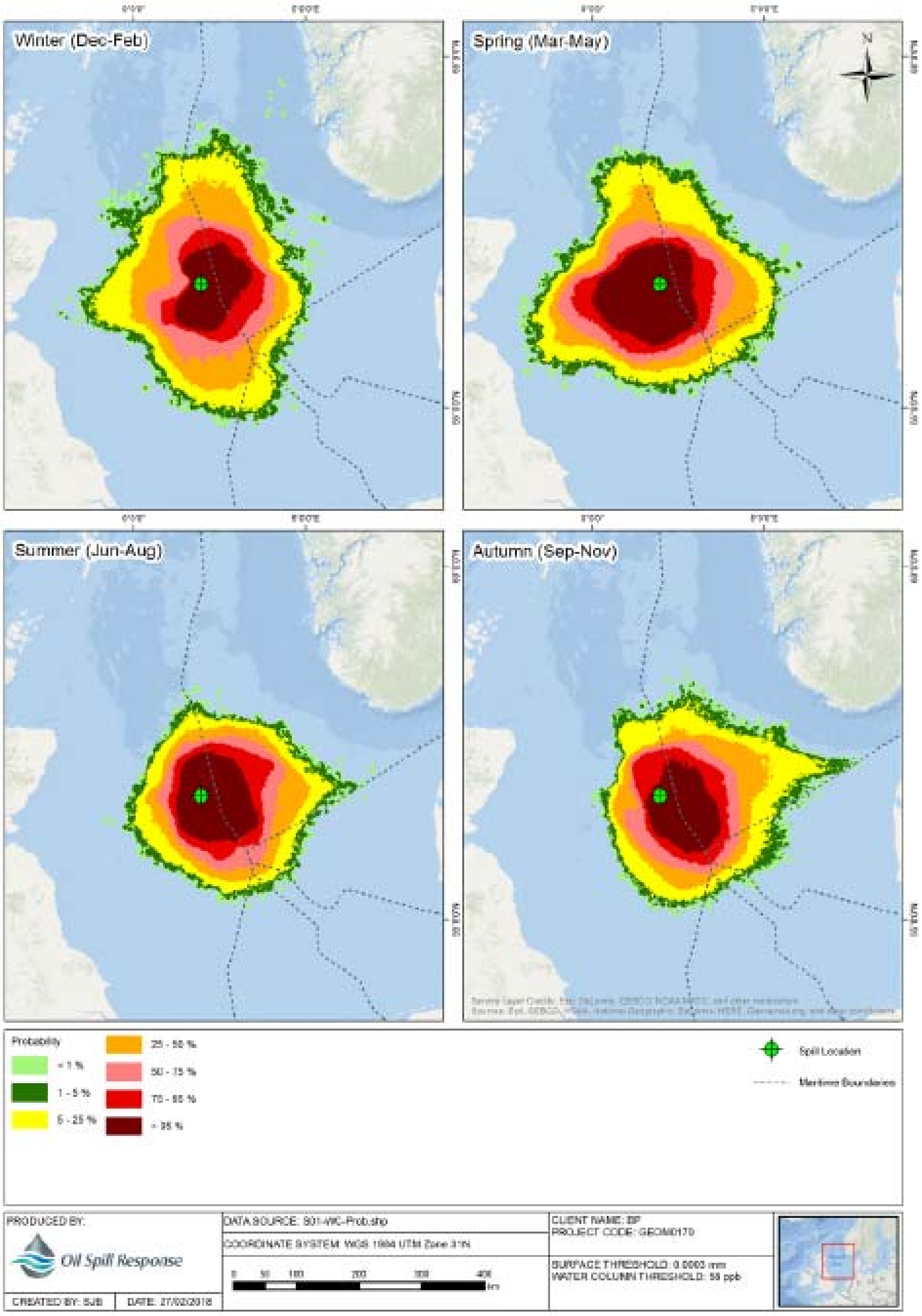
Dogger Bank (DEU) SAC	34%	9%	34%	62%
	33 days, 18 hrs	60 days, 9 hrs	24 days 9 hrs	20 days, 21 hrs
Dogger Bank (GBR) SAC	47%	11%	19%	30%
	20 days, 12 hrs	32 days, 12 hrs	28 days, 12 hrs	15 days, 12 hrs
Dogger Bank (NLD) SAC	37%	3%	25%	36%
	27 days, 21 hrs	45 days, 12 hrs	34 days, 15 hrs	16 days, 9 hrs
East of Gannet and Montrose Fields NCMPA	100%	100%	100%	93%
	1 day, 0 hrs	0 days, 15 hrs	1 day, 0 hrs	1 day 6 hrs
Farnes East MCZ	-	8%	-	-
	-	32 days 3 hrs	-	-
Firth of Forth Banks Complex NCMPA	5%	8%	-	-
	51 days, 0 hrs	18 days, 9 hrs	-	-
Fulmar MCZ	100%	100%	100%	100%
	0 days, 21 hrs	1 days, 0 hrs	0 days, 18 hrs	1 day, 3 hrs
North East of Farnes Deep MCZ	-	27%	-	-
	-	17 days, 3 hrs	-	-
Northumberland Marine potential SPA	-	<1%	-	-
	-	56 days, 18 hrs	-	-
Norwegian Boundary Sediment Plain NCMPA	44%	38%	15%	5%
	12 days, 0 hrs	12 days, 0 hrs	44 days, 12 hrs	52 days, 21 hrs
Scanner Pockmark SAC	10%	20%	-	-
	26 days, 18 hrs	32 days, 18 hrs	-	-
Southern North Sea candidate SAC	31%	9%	-	3%
	27 days, 15 hrs	44 days, 12 hrs	-	63 days, 0 hrs
Swallow Sand MCZ	56%	95%	18%	19%
	11 days, 18 hrs	9 days, 9 hrs	13 days, 9 hrs	27 days, 15 hrs

Source: BP (2018)

In addition to contaminating the sea surface, a hydrocarbon release also has the potential to contaminate the water column. Figures 6-5, 6-6 and 6-7 indicate that water column contamination will be greatest around the point of discharge, with a 95% probability of oil contamination. Contamination will reduce to less than 1% probability further from source of the blowout (within approximately 200km of the source). The track of contamination will depend on prevailing currents and the season in which the release occurs. Water quality contamination after a period of 60 days is contained to the offshore waters. Figure 6-8 indicates that the dissolved concentration will be less than $0.15mgl^{-1}$ and this will be near the well location.

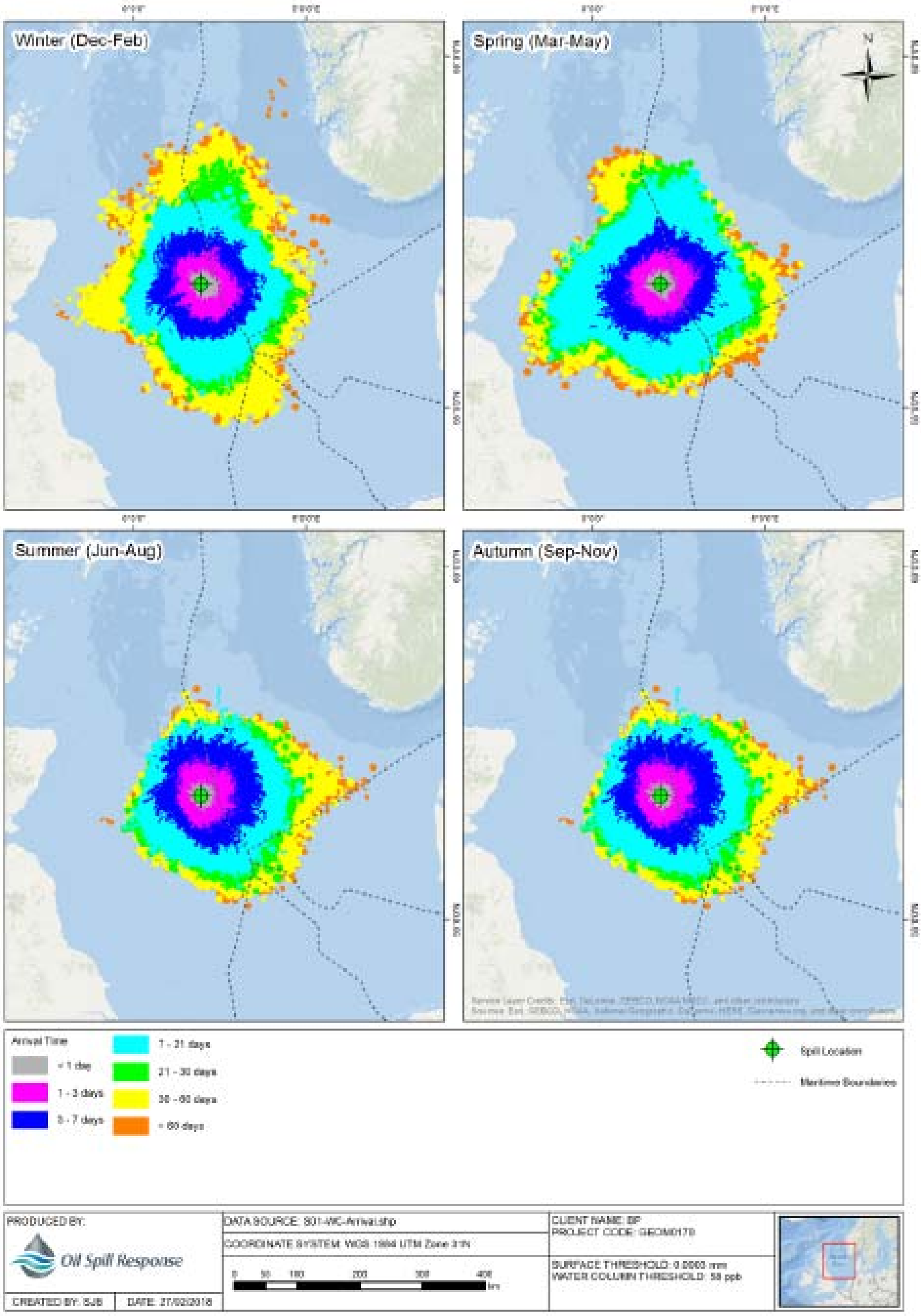
Table 6-2 shows the key protected sites which will be at risk from water column contamination (BP 2018). Due to its proximity to the VDC, the Fulmar MCZ and East of Gannet and Montrose Fields NCMPA have been identified as having the greatest probability of being impacted in the event of an unplanned release (100% probability).

Figure 6-4 Scenario 1 – probability of oil contaminating the water column (based on a threshold of 0.058ppb)



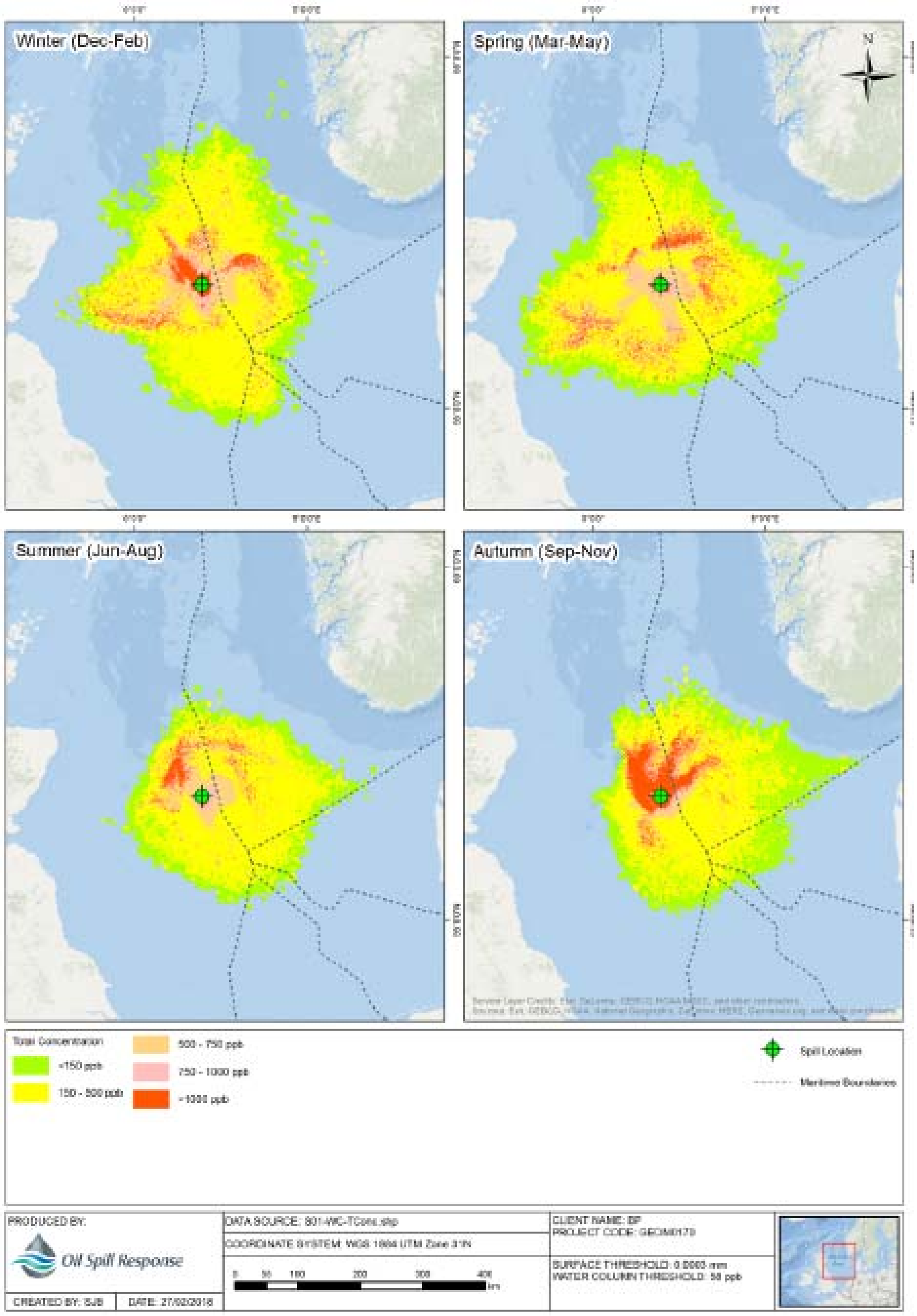
Source: BP (2018)

Figure 6-5 Scenario 1 – minimum time for oil to arrive in the water column (based on a threshold of 0.058ppb)



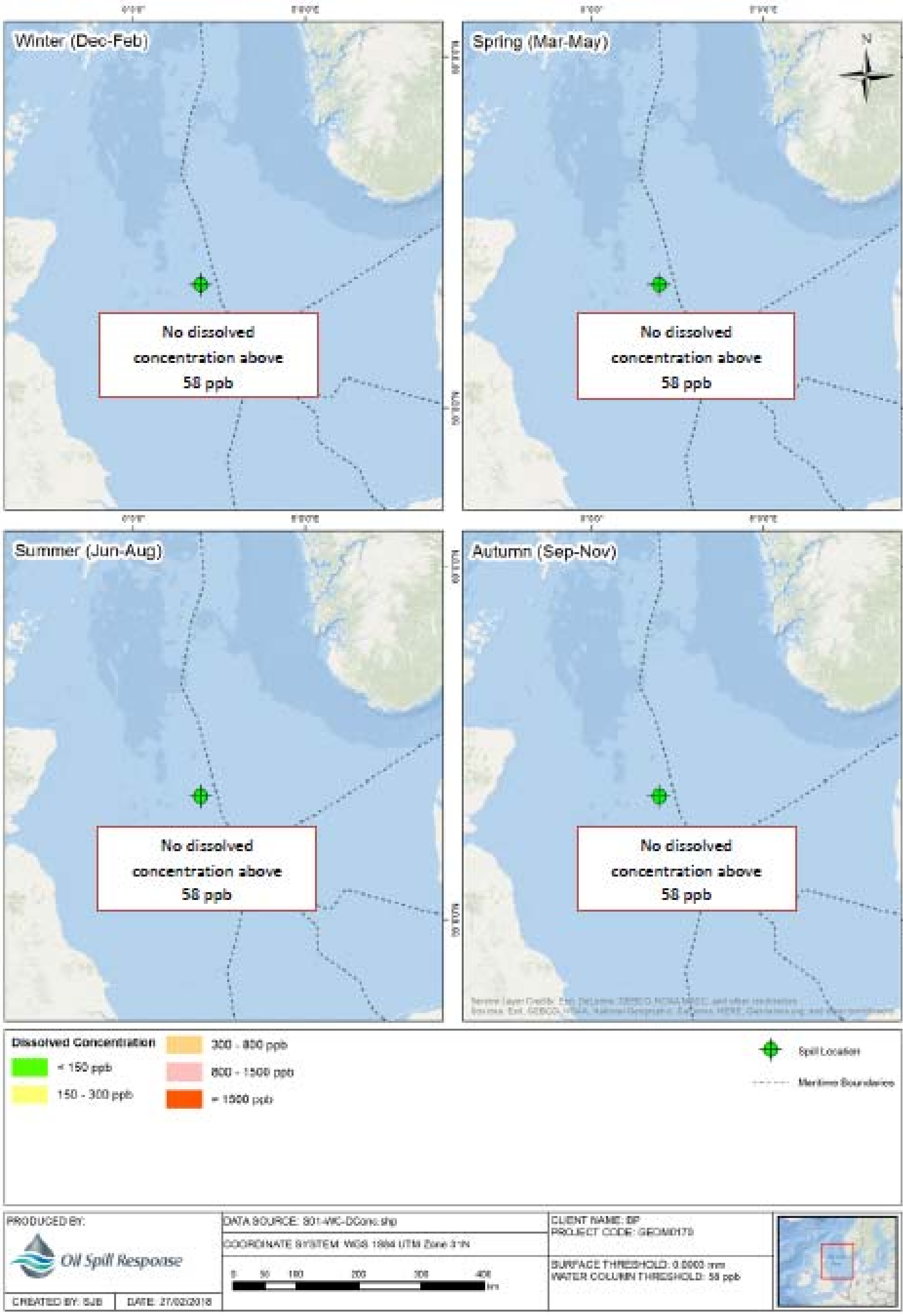
Source: BP (2018)

Figure 6-6 Scenario 1 – total hydrocarbon concentration in the water column (based on a threshold of 0.058ppb)



Source: BP (2018)

Figure 6-7 Dissolved hydrocarbon concentration in the water column (based on a threshold of 0.058ppb)



Source: BP (2018)

Table 6-4 Scenario 1 key sensitivities at risk – probability and minimum arrival times – water column

Site	Dec-Feb	Mar-May	Jun-Aug	Sep-Nov
Dogger Bank (DEU) SAC	32%	9%	39%	49%
	35 days, 15 hrs	42 days, 6 hrs	28 days, 12 hrs	20 days, 21 hrs
Dogger Bank (GBR) SAC	48%	19%	20%	31%

	20 days, 9 hrs	24 days, 0 hrs	25 days, 12 hrs	16 days, 21 hrs
Dogger Bank (NLD) SAC	36%	6%	25%	37%
	30 days, 18 hrs	66 days, 6 hrs	27 days, 18 hrs	16 days, 12 hrs
East of Gannet and Montrose Fields NCMPA	100%	100%	100%	93%
	1 days, 0 hrs	0 days, 18 hrs	1 days, 0 hrs	1 day, 3 hrs
Farnes East MCZ	-	11%	-	-
	-	36 days, 9 hrs	-	-
Firth of Forth Banks Complex NCMPA	6%	15%	-	-
	52 days, 3 hrs	19 days, 9 hrs	-	-
Fulmar MCZ	100%	100%	100%	100%
	1 day, 0 hrs	0 days, 21 hrs	0 days, 21 hrs	1 day, 3 hrs
North East of Farnes Deep MCZ	-	33%	-	-
	-	17 days, 9 hrs	-	-
Norwegian Boundary Sediment Plain NCMPA	46%	43%	16%	6%
	11 days, 18 hrs	10 days, 18 hrs	45 days, 21 hrs	53 days, 0 hrs
Scanner Pockmark SAC	12%	21%	-	-
	37 days, 9 hrs	33 days, 0 hrs	-	-
Southern North Sea candidate SAC	34%	8%	-	4%
	23 days, 21 hrs	45 days, 3 hrs	-	61 days, 6 hrs
Swallow Sand MCZ	61%	95%	21%	18%
	9 days, 21 hrs	9 days, 15 hrs	12 days 12 hrs	22 days, 0 hrs

Source: BP (2018)

6.5 Environmental impacts of a hydrocarbon release

The potential environmental impacts of an unplanned hydrocarbon release have been assessed with reference to the key sensitive receptors. A review of the environmental effects of the Deepwater Horizon oil spill undertaken by Beyer *et al*. (2016) identifies that oil is toxic to a range of organisms and that the effects of oil to planktonic species, fish, seabirds, marine mammals and reptiles can be result in a wide array of adverse effects (such as impaired growth, reduced reproduction and impaired physiological health) or mortality.

In addition, in the event of a sustained well blowout, there is the potential for loading of greenhouse gases resulting from the emission of unburnt gas, adding to global climate change.

The magnitude of the impact results from a combination of size of the release; properties of the oil; metocean conditions when the release occurs; and sensitivity of the receiving environment. In the case of the Vorlich development, the types of hydrocarbon present in sufficient quantities to result in a MEI are restricted to Group 1 oils (i.e. condensate and oil, specific gravity below 0.8). These are considered non-persistent in the marine environment, and modelling (Figure 6-7) indicate that the total hydrocarbon concentration will disperse away from the point of release. The impacts to the marine environment resulting from a MEI are discussed below.

6.5.1 Summary of impact assessment of potential releases

The scores applied during assessment of the risk an unplanned event poses to the environment are summarised in Table 6-4 below. The risk assessment methodology is provided in Section 5.1. The assessment for key sensitive receptors is discussed below.

Table 6-5 Risk matrix – summary of assessment results

	Environmental receptor											
Unplanned event	**Air quality**	**Water quality**	**Sediment**	**Plankton**	**Benthos**	**Fish and shellfish**	**Seabirds**	**Marine mammals**	**Protected sites**	**Shipping**	**Commercial fisheries**	**Other marine users**
Major hydrocarbon release		3-A				3-A	3-B	3-A	1-A			
Minor Hydrocarbon release		1-B	1-B	1-B	1-B	1-B			1-B			
Chemical release		1-B	1-B	1-B	1-B	1-B			1-B			

6.5.2 Plankton and fish

Unplanned releases have the potential to cause toxic harm to plankton and fish communities (Beyer *et al.* 2016). In general, lighter refined petroleum products such as diesel and gasoline are more likely to mix in the water column and are therefore more toxic to marine life. However, they tend to evaporate quickly and do not persist long in the environment as soluble components are readily biodegradable. Direct effects to plankton and fish larvae have been recorded following oil spills, including mortality. However no effects on the numbers in adult populations have been identified, due to the typically large areas over which spawning occurs (ICIECA 2015). Instances that could result in risk to the stocks include large scale oil release, a release occurring during a spawning period or a release occurring in an area where there are limited suitable spawning grounds available (ICIECA 2015). As identified in Figure 4-5, the development is located within four spawning grounds. These spawning grounds are extensive and not limited to the area of the North Sea potentially affected by the extent of oiling from a well blowout scenario. Additionally, it is identified in ICIECA (2015) that many fish are territorial, while they are likely to avoid an area during an event such as an oil spill. Therefore, a hydrocarbon release from an unplanned event at Vorlich is unlikely to have a significant impact on the plankton and fish community at population level.

The assessment concluded that a release poses an acceptable risk to plankton and fish (Table 6-4).

6.5.3 Marine mammals

All cetacean species are EPS and are protected under Annex IV of EC Directive 1992/43/EEC (Habitats Directive). Harbour porpoise, bottlenose dolphin and common seal are listed under Annex II of the Habitats Directive which lists species whose conservation requires protection of a SAC.

Accidental releases of hydrocarbons present a risk to cetacean and pinniped species near the release, due to their toxic nature and ability to clog up breathing passages (blow holes). Cetaceans have smooth hairless skins over a thick layer of insulating blubber, so hydrocarbons are unlikely to adhere persistently or cause breakdown of insulation. Marine mammals must surface to breathe and they may inhale vapours given off the hydrocarbon slick; their eyes may also be vulnerable to hydrocarbons. In addition, indirect effects may be caused though contamination and depletion of food resources. Due to the transient nature of cetaceans, it is likely that individuals not in the immediate area of the release will avoid the area.

Modelling indicates that there is a 34% probability of oil entering into the Southern North Sea cSAC within 23 days between December and February, an 8% probability between March and May after 45 days, and a 4% probability after 61 days. Harbour porpoise is a designating feature of this protected site. The extent of the Southern North Sea cSAC is 36,951km^2 (JNCC 2017) and harbour porpoise are highly mobile species, present across the wider North Sea. In December to February, a period of the highest probability of the oil entering the Southern North Sea cSAC, research indicates that harbour porpoise are concentrated in the southern extent of the cSAC (off East Anglia and Thames Estuary) (JNCC 2017) and densities of harbour porpoise within the development area are expected to be very low (see Section 4.4.5.1). Additionally, other marine mammals identified as present near the development area are also typically observed in low densities (see Section 4.4.5.1). Thus, while individual marine mammals may be impacted near a release there is unlikely to be a significant wider impact. As such an unplanned hydrocarbon release resulting from well blowout has been assessed as posing an acceptable risk to marine mammals (Table 6-4).

Given that there is only a 2% chance of the release beaching the shoreline it is not expected that the hydrocarbon release will impact any of the SACs listed in Section 4.5.5.4 designated to protect marine mammals.

6.5.4 Seabirds

Section 4.4.4 discussed that seabird sensitivity to oiling in the development area as low throughout the year. In neighbouring Blocks, sensitivity to oil is generally low with moderate sensitivity to oiling south east of the development area in February, and high sensitivity to oiling north of the development area in September and October. Considering the following:

- Probability of a MEI incident occurring is low;
- Type of oil present are Group 1 hydrocarbons; and
- Modelling results indicate that while slick area is extensive, the slick will rapidly disperse following cessation of the release

the impact assessment concluded that the risk to marine birds is tolerable, which with the implementation of mitigation measures listed in Table 6-8 is reduced to acceptable.

6.5.5 Protected sites

The ten offshore marine protected sites within 150km of the development are designated primarily to protect physical features (e.g. sandbanks, reefs) or seabed habitats. All sites are continuously submerged. Group 1 oils (s.g. <0.8) will not sink and therefore the sites without EPS or Annex II species as a designating or qualifying feature are not considered to be at risk from hydrocarbon releases.

An EPS, harbour porpoise, is a designating feature of the Southern North Sea cSAC. Oil spill modelling has identified there is a probability of 34% that oil will enter into this area in the event of MEI (discussed further in Section 6.5.3).

If a MEI was to occur, noting that the probability of such an event is low (Section 6.2.2), it is unlikely that it would affect the conservation status of any of the sites. In addition, the probability of the spill beaching in coastal areas is only 2% and is therefore unlikely to affect coastal protected sites.

The assessment concluded (see Table 6-4) that an unplanned release poses an acceptable risk to protected sites.

6.5.6 Aquaculture sites

Given that a release only has a 2% probability of beaching on the coast, it is unlikely that it will have any impact on aquaculture sites.

6.6 Environmental impacts from chemical releases

Chemicals which are registered for use in UKCS operations may include components which have properties (based on their toxicity, persistence in the marine environment and potential to bioaccumulate) which have caused them to be in included in the list of candidates for substitution. Use of products containing such components is subject to justification, including means to minimise exposure (e.g. by use in zero discharge applications only) and replacement strategy for the component(s) of concern.

Toxic impacts are most likely to be on water column species, particularly fish and plankton, although benthic species could also be at risk in the case of chemicals which are denser than water or are particle active and therefore enter the sediment. Where chemicals have the potential to form surface slicks (i.e. are both immiscible with and less dense than water) impacts will be similar to those of small volume oil releases.

The probability of a potentially harmful quantity of a chemical being discharged and causing an adverse impact, is low.

6.7 Mitigation

It is BP and Ithaca policy that operations are conducted in such a manner as to minimise the risk of hydrocarbon and chemical spillage and pollution. Risk assessment processes are used to identify potential risks, their severity, and identify barriers to those risks materialising. Where residual risks remain, management and mitigation measures are put in place to reduce the likelihood and extent of any potential unplanned releases.

There are two key levels of mitigation for hydrocarbon releases - prevention and control.

Table 6-5 demonstrates the measures that will be implemented to minimise the risks of unplanned releases:

Table 6-6 Mitigation measures

Mitigation measure	Summary of controls
M14	**Prevention** - All operational personnel, whether in the direct employ of BP, Ithaca or contractors will be made aware of existing environmental protection procedures and the crucial importance of maintaining the integrity of the containment policy. The risk of a spill is tackled on a day-to-day basis by Vorlich partners employees and contractors following good practice codes, collision avoidance and fuel handling and transfer procedures. Every effort will be made to prevent such releases. It is noted that most releases occur during offshore fuel transfer operations (bunkering) and as such BP are committed to the following measures during drilling operations: The connection between the fluid transfer hose and the supply vessel for offshore hydrocarbon and brine transfers shall be a self-sealing, dry-break hose connection. Preference shall be given to carrying out external fluid transfers during the hours of daylight. If operational reasons dictate that external fluid transfer are carried out during the hours of darkness then they shall be subject to documented risk assessment which shall include environmental and safety considerations. Fluid transfer during hours of darkness shall not commence without provision of sufficient illumination to allow the entire length of the transfer hose to be visually monitored from the installation. If operational reasons dictate that simultaneous external fluid transfers of more than one hydrocarbon fluid product is required, it shall not take place until a full documented risk assessment has been made.
M15	**Control** - In line with the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015 and the Offshore Installations (Emergency Pollution Control) Regulations 2002 an approved OPEP will be in place for the project. This will cover response measures to be taken to protect the environment in the event of a spill. As discussed in the preceding section, this OPEP provides detailed hydrocarbon release and spill

	scenarios to enable the determination of appropriate offshore actions. In addition, it outlines reporting and training requirements for mitigating accidental spillage throughout all phases. BP operates a three-tier response system, based on the following key factors: hydrocarbon type and properties, potential quantities released, metocean and metrological data, environmental and economic sensitivities and the response capabilities of both BP and OSRL. ▪ Tier 1 is a local response, geared at the most frequently anticipated oil spill. ▪ Tier 2 is a regional response for a less frequently anticipated oil spill where external resources and assistance in monitoring and clean-up will be required. ▪ Tier 3 is a national response for very rarely anticipated oil spills of major proportions which will potentially require national and international resources to assist in protecting vulnerable areas and in the clean-up. The response strategies available following a release include aerial surveillance, application of dispersant, well capping, and drilling of relief wells. Any spills (diesel, condensate or chemical), including sheens, will be reported to the statutory authorities using the PON1 reporting system. For larger spills, a comprehensive range of back-up resources is available to BP through oil spill providers e.g., OSRL. However, the likelihood of a blow-out occurring is extremely rare.

In addition to applicable mitigations listed in Table 6-5, the following mitigation measures will be in place to prevent or control a well blowout scenario:

- A shallow gas survey has been undertaken and has not identified any risks at proposed well/ drill centre location.
- All wells are designed as per the requirements within the BP Global Wells Organisation standards and specifications.
- BP has access to OSRLs cap and contain system in the event of a Tier 3 event, to restore well control.
- Weighted drilling fluids as per design provide the primary barrier during drilling activities. Fluids are weighted to counterbalance the formation pressure. These fluids are rigorously controlled and monitored.
- The secondary barrier will be a BOP. BOPs consist of a series of individual preventers which will be installed on the wellhead at the seabed after the top-hole sections have been drilled. BOPs will be rated for pressures in excess of those expected to be encountered whilst drilling.

6.8 Residual impact

Residual impacts, if an event occurs, remain potentially severe. Mitigation measures and adherence to legal measures are intended to reduce the likelihood of such an event occurring, reducing the risk to the environment to an acceptable level.

7. IN-COMBINATION, CUMULATIVE AND TRANSBOUNDARY IMPACTS

7.3 In combination and cumulative impacts

In accordance with the Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017, the assessment has considered cumulative and in-combination impacts.

The term 'in-combination impacts' refers to impacts upon receptors from different activities within the same project. The way in which the EIA has been conducted e.g. by looking at the impacts of project activities on receptors, means that intrinsically it has already considered in-combination impacts. For example, Section 5.6 assesses the impact of different pathways of disturbance of seabed habitats i.e. drill cuttings deposit, anchoring and deposit of infrastructure; all activities which in-combination have the potential to impact habitats in an additive manner. In-combination impacts are therefore not discussed further in this section.

The term 'cumulative impact' refers to impacts upon receptors arising from the Vorlich development when considered alongside other past, present or reasonably foreseeable projects, plans or licensed activities, that may result in an additive impact with any activities of the development. The assessment below considers the potential for activities at Vorlich to interact with:

- Other oil and gas developments;
- Wind farm developments;
- Aggregate extraction and disposal sites; and
- Other marine users.

There are no windfarm developments, aggregate extraction and disposal sites or any other projects or plans except oil and gas developments which could have the potential to interact with the activities in the Vorlich development area.

The closest oil and gas producing and developing fields to the development area are:

- Stella field located 4m to the south;
- Jade field located 10km to the west;
- Harrier field is located 4km to the south;
- Judy field located 17km to the south east;
- Jasmine field located 5km to the south east; and the
- Franklin field located 10km to the north west.

The assessment then considers if a combination of activities from the fields above will have a cumulative impact on the receptors. Activities assessed include seabed disturbance leading to habitat loss, generation of underwater noise, increased activity in the region, generation of atmospheric emissions and marine discharges.

7.3.1 Seabed distrubance leading to habitat loss

Section 5.6 estimated that the permanent footprint of the development will be at worst 10,010.25m^2 (0.01km^2). Given that the development area is located 4km from the nearest development and is in an area where no sensitive habitats have been observed there is not expected to be a cumulative effect on habitat loss. In addition, the development is already located within a well-developed area of the North Sea. Therefore, the permanent footprint of the development will pose an acceptable risk of a cumulative impact on the area given the small footprint of the development.

7.3.2 Generation of underwater noise

During piling and installation activities at Vorlich there will be a short-term occurrence of underwater noise. However, the noise assessment (Section 5.4) concluded that the risk posed to the environment from underwater noise is acceptable. BP is not aware of any marine surveys or pilling activities near to the development. However, for conservatism, it is assumed that such activities will take place in the fields close to Vorlich during development construction. The development area is located 4km from the closest development. Piling, the activity that generates the most significant underwater noise, will be a one-off, very short duration (approximately four hours) event. It is therefore not likely that it would contribute significantly to cumulative effects on environmental receptors.

The development is in an area which has existing levels of background noise from vessel traffic and oil and gas activities. Marine species will have some tolerance to anthropogenic noise in the area. Therefore, noise levels created from the development are assessed to have an acceptable risk of causing a cumulative impact on marine species in the area.

7.3.3 Shipping and commerical fishing

The development has the potential to further displace fishing vessels and place restrictions on navigation in an area where exclusions and restrictions already occur. There will be a temporary 500m exclusion zone around the drilling rig and pipeline installation has the potential to displace vessels as pipelay vessels travel between the VDC and FPF-1. However, these restrictions will be temporary and will only affect a small area. The development is not expected to have a significant cumulative impact on fishing and navigation in the area.

7.3.4 Generation of atmospheric emissions

Greenhouse gas emissions from the development will be a small contributor to the overall UK emissions (Section 5.3). This combined with emissions from other developments in the area has the potential to result in an increased impact on the air quality in the region. However, given the distance to landfall (241km) and the anticipated rapid dispersion and dilution of emissions that will occur under prevailing meteorological conditions, it is unlikely that the development will significantly contribute to cumulative effects of atmospheric emissions on air quality.

7.3.5 Marine discharges

Discharges from drilling (muds, drill cuttings and cements) deposited on the seabed are not expected to result in a significant cumulative impact on seabed contamination in the area, given that deposits will be eroded and leached over time (OSPAR 2009) and will only impact a small area of the seabed (440m^2). Chemical discharges from drilling, production and pipeline operations have the potential to cause a cumulative toxic impact. However, discharges will be localised and rapidly diluted and dispersed. Therefore given that the development is located 4km from the nearest development no cumulative impacts are expected.

7.3.6 Unplanned event

The development is in an already well-developed area of the North Sea and there is potential for the impacts associated with an accidental hydrocarbon release to act cumulatively with an accidental release from another offshore installation. However, it is very unlikely that a single or simultaneous event would occur and therefore the probability of a cumulative impact from an accidental hydrocarbon release is very low.

7.3.7 Mitigation measures

It is considered that the development will not result in any significant in- combination and cumulative impacts. Therefore, no additional mitigation measures, other than those outlined in Section 6, have been proposed.

7.4 Transboundary Impacts

Due to the proximity of the UK/Norway median line (23km to the east of the development), there is potential for transboundary air quality impacts. However, emissions from the development will disperse under prevailing meteorological conditions before crossing the median line, therefore emissions are not expected to cause a significant transboundary impact.

Planned marine discharges are also not expected to cause a significant transboundary impact. The environment is sufficiently dynamic to encourage adequate dispersion of any permitted discharges.

Subsea installation of the development will take place in UK waters therefore there will be no transboundary impacts resulting from noise, seabed disturbance and physical presence; the disturbance zones will not reach the median line (see Section 5.4 – noise assessment, Section 5.6 seabed footprint and Section 5.2 – physical presence).

As discussed in Chapter 6, the oil spill modelling indicates that the well blowout scenario, may result in the oil crossing the median line, both at the surface and within the water column, however, oiling of international shorelines is not predicted to occur. In the event of a unplanned release crossing the median line, international cooperation will be necessary; this will be addressed within the OPEP.

7.5 Summary of impact assessment

The scores applied during assessment of the risk the cumulative and transboundary impacts pose to the environment are summarised in Table 7-1 below. The risk assessment methodology is provided in Section 5.1.

Table 7-1 Risk matrix – summary of assessment results

	Environmental receptor											
Unplanned event	Air quality	Water quality	Sediment	Plankton	Benthos	Fish and shellfish	Seabirds	Marine mammals	Protected sites	Shipping	Commercial fisheries	Other marine users
Cumulative impacts	1-B	1-B	1-B	1-B	1-B	1-B	1-B	1-B	1-B	1-B	1-B	1-B
Transboundary impacts	1-A	1-A										

8. CONCLUSIONS

8.1 Approach to EIA

This ES reports the results from the EIA which was conducted to evaluate the environmental impacts of the Vorlich development under the requirements set out in the Offshore Petroleum Production and Pipelines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017.

The following methodology was applied to assess the possible impacts of the Vorlich development:

- Describe the physical, biological and socio-economic environment of the area;
- Identify activities within the operation with the potential to impact these receptors;
- Determine the risk posed to the environment by considering the severity of impact and the likelihood of occurrence;
- Propose mitigation measures to reduce either the severity of the impact or the likelihood of occurrence; and
- If necessary, re-assess impacts post-implementation of mitigation measures to determine residual impact.

8.2 Baseline environment

The development area is typical of a central North Sea offshore environment in a well-developed oil and gas area. The prevailing biotope complex in the area is circalittoral muddy sand. Photographs of the seabed show a muddy sand seabed with relatively sparse epifauna and evidence of deep burrowing animals. Individual ocean quahogs have been identified, but currently no aggregations have been observed. Six fish species have been identified as spawning and nursing in the area; of which one is a demersal spawner (sandeel). It is unlikely that sandeel use the development area for spawning given the water depth. Four species of cetaceans have been observed in the development area, in low to moderate densities. Observations are more frequent between July and November. Seabird sensitivity to oil pollution in the development area is low throughout the year. The closest protected sites are the Fulmar MCZ and East of Gannet and Montrose Fields NCMPA, both 29km distant. The development area is in an area of low fishing intensity situated in relatively open water, with sufficient sea room available for passing vessels to safely navigate around the field.

8.3 Potential hazards, effects and mitigation measures

The potential effects to the environment from installation and production were identified and assessed; this was done for planned activities and unplanned releases. Activities assessed included physical presence; generation of atmospheric emissions; generation of underwater noise; marine discharges; seabed footprint; and unplanned releases. The assessment has been based on the potential severity and likelihood of an impact using the criteria described in Section 5.1.1. The assessment rated the risk to the environment as either acceptable, tolerable or unacceptable. The assessments assume that activities will be carried out in accordance with all current legislation and industry best practice.

The assessment did not identify any unacceptable environmental risks and concluded that most of the planned activities present an acceptable risk to the environment. A tolerable risk to seabirds in the event of a worst-case unplanned release (i.e. loss of well control resulting in well blowout) was identified. However, the residual risk is reduced to acceptable if the mitigation measures, safeguards and controls and the low likelihood of such an event occurring, is considered.

The impacts resulting from the development have the potential to act cumulatively with impacts from past, present or reasonably foreseeable projects, plans or licensed activities in the area. Activities assessed for cumulative effects include seabed disturbance leading to habitat loss, generation of underwater noise, increased activity in the region, generation of atmospheric emissions and marine discharges. It was concluded that the development would not contribute to a significant cumulative impact.

In the event of a MEI, which for this development was identified to be a well blowout, modelling has identified that it is likely that oil will enter Norwegian waters. Therefore, a need for international cooperation has been identified and will be covered within the field OPEP.

Mitigation measures identified in this EIA are listed below:

ID	Mitigation measures
M1	Project vessels will follow the IMO standards to reduce the likelihood of collision i.e. shall comply with Standard Marking Schedule. This includes requirements for navigation, lighting, obstruction lighting and beacons.
M2	Users of the sea will be notified of the presence and intended movements of the project vessels via the Kingfisher Fortnightly Bulletins, Notices to Mariners, Notice to Lighthouse Board, and VHF radio broadcasts
M3	BP and Vorlich partners will undertake practical steps, such as ensuring efficient operations, keeping power generation equipment well maintained and monitoring fuel consumption, to minimise atmospheric emissions.
M4	All vessels employed during drilling activities will comply with the Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008, which controls the levels of pollutants entering the atmosphere.
M5	Inspection and maintenance programmes will be used in line with the requirements of indicative BAT to ensure that power generation equipment is kept and operated in a manner to optimise efficiency and minimise fuel consumption.
M6	BP and Vorlich partners will be required to review BAT assessments as part of the application for permission to vent and flare associated with the drilling/ FPF-1 installation. These assessments and the subsequent permits will ensure that greenhouse gas emissions are kept to the minimum consistent with operational requirements for maintaining the development.
M7	A dedicated Marine Mammal Observer will conduct visual surveys during piling activities within hours of daylight.
M8	The JNCC protocol for minimising the risk of injury to marine mammals from piling noise will be followed. This includes: ▪ Slow start up i.e., gradual ramping up of power, will be used during piling to ensure that any mammals will have sufficient time to leave the area. The soft start up duration will not be less than 20 minutes. ▪ Dedicated MMOs will be on board for the duration of the piling. If a marine mammal is detected within 500m of the operational site during the soft start, then, if possible, the setting of the manifold will cease or at the least the power will not be ramped up further until the marine mammal has left the zone and there has been no further detection for at least 20 minutes. If there is a break in the driving operations for a period of greater than 20 minutes a soft start procedure will be repeated.
M9	Chemical use and discharge will be regularly reviewed and kept to the minimum consistent with operational requirements.
M10	Where suitable alternatives are available and deemed fit for purpose, chemicals with lower potential for environmental impact will be reviewed.
M11	Chemical storage and usage is in accordance with the vessel's COSHH procedure and Material Safety Data Sheets are carried for all hazardous substances.
M12	Rock placement will only be employed where the integrity of the pipeline is at risk. Cover will be kept at the minimum required to ensure pipeline protection is adequate. Industry best practice shall be used when deploying rock dump.
M13	The manifold is designed to be a slab-sided fishing friendly structure with no snaggable protrusions.
M14	**Prevention** - All operational personnel, whether in the direct employ of BP or contractors will be made aware of existing environmental protection procedures and the crucial importance of maintaining the integrity of the containment policy. The risk of a spill is tackled on a day-to-day basis by Vorlich partners employees and

<table>
<tr><th>ID</th><th>Mitigation measures</th></tr>
<tr><td></td><td>contractors following good practice codes, collision avoidance and fuel handling and transfer procedures. Every effort will be made to prevent such releases. It is noted that most releases occur during offshore fuel transfer operations (bunkering) and as such BP are committed to the following measures during drilling operations:

The connection between the fluid transfer hose and the supply vessel for offshore hydrocarbon and brine transfers shall be a self-sealing, dry-break hose connection.

Preference shall be given to carrying out external fluid transfers during the hours of daylight. If operational reasons dictate that external fluid transfer are carried out during the hours of darkness then they shall be subject to documented risk assessment which shall include environmental and safety considerations.

Fluid transfer during hours of darkness shall not commence without provision of sufficient illumination to allow the entire length of the transfer hose to be visually monitored from the installation.

If operational reasons dictate that simultaneous external fluid transfers of more than one hydrocarbon fluid product is required, it shall not take place until a full documented risk assessment has been made.</td></tr>
<tr><td>M15</td><td>Control - In line with the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015 and the Offshore Installations (Emergency Pollution Control) Regulations 2002 an approved OPEP will be in place for the project. This will cover response measures to be taken to protect the environment in the event of a spill. As discussed in the preceding section, this OPEP provides detailed hydrocarbon release and spill scenarios to enable the determination of appropriate offshore actions. In addition, it outlines reporting and training requirements for mitigating accidental spillage throughout all phases.

BP operates a three-tier response system, based on the following key factors: hydrocarbon type and properties, potential quantities released, metocean and metrological data, environmental and economic sensitivities and the response capabilities of both BP and OSRL.
▪ Tier 1 is a local response, geared at the most frequently anticipated oil spill.
▪ Tier 2 is a regional response for a less frequently anticipated oil spill where external resources and assistance in monitoring and clean-up will be required.
▪ Tier 3 is a national response for very rarely anticipated oil spills of major proportions which will potentially require national and international resources to assist in protecting vulnerable areas and in the clean-up.

The response strategies available following a release include aerial surveillance, application of dispersant, well capping, and drilling of relief wells. Any spills (diesel, condensate or chemical), including sheens, will be reported to the statutory authorities using the PON1 reporting system. For larger spills, a comprehensive range of back-up resources is available to BP through oil spill providers e.g., OSRL. However, the likelihood of a blow-out occurring is extremely rare.</td></tr>
</table>

8.4 Environmental Management

BP and Ithaca's Environmental Management System (EMS) will encompass all project activities associated with the development, from design through to decommissioning, including services provided by contractors. It will provide the development project with a robust framework for establishing environmental objectives and targets, managing environmental impact and risk within these targets, monitoring and reviewing effectiveness and compliance, and developing further technical and operational improvements, if required. Both BP and Ithaca, on behalf of the Stella Joint Venture, have systems in place to identify and apply compliance requirements across the key project phases, i.e. design, installation, commissioning, and operations.

A commitment register has been developed to address the different aspects of the Vorlich development. During the implementation of the development, objectives and targets will also be used to set goals for continuous improvement in performance to follow the commitments set out in the register. In this way, environmental management is an ongoing process; it will continue beyond implementation of the mitigation measures identified during this EIA to strive for continuous improvement and to meet changing regulatory requirements.

8.5 Overall conclusion

It is concluded that the current proposed development can be completed without causing any unacceptable or tolerable risks to the environment.

REFERENCES

1 Aires, C., González-Irusta, J.M., Watret, R (2014). Scottish Marine and Freshwater Science Report. Vol 5 No 10. Updating Fisheries Sensitivity Maps in British Waters.

2 Anatec (2018). Vorlich (Block 30/01) Consent to Locate. Technical Note. Ref: A4138-BP-TN-1. February 2018.

3 "ASCOBANS (2011). 18th ASCOBANS Advisory Committee Meeting. Report of the open-ended Inter-sessional Working Group on Noise. Agenda Item 4.4. Bonn, Germany. May 2011.

4 Battelle (2005). Scoping Report for the National Marine Fisheries Service Environmental Impact Statement for National Acoustic Guidelines on Marine Mammals. May 2005.

5 Beare, D.J., Batten, S., Edwards, M. & Reid, D.G. (2002). Prevalence of boreal Atlantic, temperate Atlantic and neritic zooplankton in the North Sea between 1958 and 1998 in relation to temperature, salinity, stratification intensity and Atlantic inflow. Journal of Sea Research, 48, 29 – 49.

6 Beyer, J., Trannum, H.C., Bakke, T., Hodson, P.V., Collier, T.K. (2016). Environmental effects of the Deepwater Horizon oil spill. Marine Pollution Bulletin 110 (2016) 28-51.

7 BODC (1998). The United Kingdom Digital Marine Atlas (third edition). Natural Environment Research Council.

8 BP (1996). ETAP Development. Environmental Assessment. Revision 0. March 1996.

9 BP (2009). Metocean criteria for the ETAP/Marnock Field – North Sea. Document No. A-210X-00x07-0006. August 2009.

10 BP (2018). Vorlich Oil Spill Modelling Report. Completed by ORSL on behalf of BP.

11 Calesurvey (2014). FPF-1 to SAL Base Survey. Habitat Assessment Report (HAS). Reference: 115K.05. Document number: STE-SF-CC-SU-RE-0005. January 2014.

12 Cato, D.H. (2009) Measurements of Anthropogenic and Natural Ambient Noise in the Context of Effects on Marine Animals. Available online at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.540.6464&rep=rep1&type=pdf.

13 Coull, K.A., Johnstone, R., and Rogers, S.I. (1998). Fisheries Sensitivity Maps for British Waters. Published and distributed by UK Oil and Gas.

14 Curtin University (2017). New research reveals impact of seismic surveys on zooplankton. Media Release Friday 23 June 2017. Available online at http://news.curtin.edu.au/media-releases/new-research-reveals-impact-seismic-surveys-zooplankton/.

15 Dann, N., Heessen, H. and Hofstede, R (2005). North Sea Elasmobranchs: distribution, abundance and biodiversity. Technical report produced for a Theme session on elasmobranch fisheries sciences for ICES. ICES CM 2005/N: 06.

16 DECC (2009). Offshore Energy Strategic Environmental Assessment. Appendix 3. Department of Energy and Climate Change. January 2009.

17 DECC (2015). Greenhouse gas reporting - Conversion factors 2015. Available online at https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2015.

18 DECC (2016a). Offshore Energy Strategic Environment Assessment. Appendix 1. Department of Energy and Climate Change. March 2016

19 DECC (2016b). UK Offshore Energy Strategic Environmental Assessment. OESEA3. Environmental Report. March 2016.

20 Defra (2007). Conserving Biodiversity - The UK Approach. UK Bioiversity Action Plan. Department for Environment, Food and Rural Affairs.

21 Defra (2011). Causes of Air Pollution. Department for Environment, Food and Rural Affairs. Available online at http://uk-air.defra.gov.uk/air-pollution/causes

22 Defra (2015). Interactive Monitoring Networks Map, UK-Air. Department of Environment, Food and Rural Affairs. Available online at http://uk-air.defra.gov.uk/interactive-map.

23 HSE (2003). Ship/platform collision incident database (2001). Prepared by Serco Assurance for the Health and Safety Executive 2003. Available online at http://www.hse.gov.uk/research/rrpdf/rr053.pdf

24 Dore, C.J., Murrells, T.P., Passant, N.R., Hobson, M.M., Thistlethwaite, G., Wagner, A., Li, Y., Bush, T., King, K.R., Norris, J., Coleman, P.J., Walker, C., Stewart, R.A., Tsagatakis, I., Conolly, C., Brophy, N.C.J., and Hann, M.R. (2008). UK Emissions of Air Pollutants 1970 to 2006. Issue 1. AEA Technology plc prepared for Defra.

25 DTI (2001). Strategic Environmental Assessment of the Mature Areas of the Offshore North Sea SEA 2. September 2001.

26 Ellis, J., Milligan, S. Readdy, L., Taylor, N and Brown, M. (2012). Spawning and Nursery Grounds of Selected Fish Species in UK Waters. Science Series Technical Report No. 147. CEFAS, Lowestoft.

27 EUNIS (2012). Habitats Names and Descriptions. Available at: http://eunis.eea.europa.eu/habitats-names.jsp?_sm_au_=ijVgMJQVpsqFWkTr

28 Fugro (2016). BP Vorlich Environmental Desk Study. J/3/21/2997. February 2016.

29 Fugro (2017). Habitat Assessment. Vorlich Development. UKCS Blocks 30/1c and 30/6a. Document No. 175505.3v2.0. December 2017.

30 Fugro (2017). Route survey, Vorlich UKCS Blocks 30/1c&30/6a Survey Period. Ref 175505.3

31 Fuzzi, S., Baltensperger, U., Carslaw K., Decesari S., Denier van der Gon H., Facchini M. C., Fowler D., Koren I., Langford B., Lohmann U., Nemitz E., Pandis S., Riipinen I., Rudich Y., Schaap M., Slowik J. G., Spracklen D. V., Vignati E., Wild M., Williams M., and Gilardoni S. (2015). Particulate matter, air quality and climate: lessons learned and future needs. Atmos. Chem. Phys., 15, 8217–8299, 2015

32 Gausland, I. (2003). Seismic Surveys Impact on Fish and Fisheries. Report for the Norwegian Oil Industry Association (OLF). Stavanger, March 2003.

33 Genesis Oil and Gas Consultants (2011a). Review and Assessment of Underwater Sound Produced from Oil and Gas Sound Activities and Potential Reporting Requirements under the Marine Strategy Framework Directive. Reference J71656. July 2011. Prepared for Department of Energy and Climate Change. Available online at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/50017/finreport-sound.pdf.

34 Genesis Oil and Gas Consultants (2011b). North Uist Exploration Well Environmental Statement, BP Document Reference W/4123/2011.

35 Hammond, P., Lacey, C., Gilles, A., Viquerat, S., Borjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M., Scheidat, M., Teilmann, J., Vingada, J. and Oien, N. (2017). Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS III aerial and shipboard surveys. Sea Mammal Research Unit, University of St Andrews, Scotland UK.

36 Health & Safety Executive (2003). Ship/platform collision incident database (2001). Research Report 053. Prepared by Serco Assurance. [online] Available at http://www.hse.gov.uk/research/rrpdf/rr053.pdf.

37 Health and Safety Executive (HSE) (2006). OSD Technical policy relating to seismic events hazard. Available at: http://www.hse.gov.uk/offshore/seismicevents.htm.

38 Heath, M.R., Dunn, J., Ellersten, B., Gaard, E., Gislason, A., Gurney, W.S.C., Hind, A.T., Irigojen, X., Melle, W., Niehoff, B., Olsen, K., Skreslet, S. and Tande, K.S., (2000). Comparative analysis of Calanus finmarchicus demography at locations around the northeast Atlantic. ICES Journal of marine science, 57, 1562 – 1580.

39 ICES (2017). Official Nominal Catches. Available online: http://www.ices.dk/marine-data/dataset-collections/Pages/Fish-catch-and-stock-assessment.aspx.

40 IPIECA (2015). Biological Impacts of Oil Pollution: Fisheries. IPIECA Report Series 8. Available online at: http://www.martrans.org/eu-mop/library/Vol8_Biological%20Impacts%20Fisheries_2961.64KB.pdf

41 Ithaca (2011). Ithaca Energy (UK) Ltd. Stella and Harrier Fields Development Block 30/06a.

Environmental Statement. November 2011. DECC Project Ref: D/4125/2011.

42 JNCC (2005). Buchan Ness to Collieston Coast SPA. Available at: http://jncc.defra.gov.uk/page-1922-theme=default.

43 JNCC (2010). UK Priority Species Pages – Version 1. Available at: http://jncc.defra.gov.uk/_speciespages/2627.pdf.

44 JNCC (2014). Annex I Reefs. Available online at: http://jncc.defra.gov.uk/PAGE-1448.

45 JNCC (2016). Harbour Porpoise (Phocoena phocoena) possible Special Area of Conservation: Southern North Sea Draft Conservation Objectives and Advice on Activities.

46 JNCC (2017a). East of Gannet and Montrose Fields MPA. Available online at: http://jncc.defra.gov.uk/page-6478.

47 JNCC (2017b). Fulmar MPA. Available online at: http://jncc.defra.gov.uk/page-6774.

48 JNCC (2017c). Annex I Sandbanks in offshore waters. Available online at: http://jncc.defra.gov.uk/page-1452.

49 Johns, D.G. and Reid, P.C. (2001). An Overview of Plankton Ecology in the North Sea. Technical Report TR_005 produced for Strategic Environmental Assessment-SEA2.

50 Jones, E.L., McConnell, B.J., Smout, S., Hammond, P.S., Duck, C.D., Morris, C.D., Thompson, D., Russell, D.J.F., Vincent, C., Cronin, M., Sharples, R.J. and Matthiopoulos, J. (2015). Patterns of space use in sympatric marine colonial predators reveal scales of spatial partitioning. Mar. Ecol. Prog. Ser. 534, 235–249. doi:10.3354/meps11370.

51 Judd, A.G. (2005). The Distribution and Extent of Methane-derived Authigenic Carbonate. Strategic Environmental Assessment, Area 6 (SEA6). Technical Report. pp. 69.

52 Jumars P. (2010). Granular Media. Design of Organisms for Momentum, Mass and Information Transfer. School of Marine Sciences: 481.

53 Kafas, A., Jones, G., Watret, R., Davies, I., Scott, B., (2012). Representation of the use of marine space by commercial fisheries in marine spatial planning. ICES CM I:23.

54 Kastelein (2011). Kastelein, R.A., Steen, N., de Jong C.A.F., Wensveen P. J. and Verboom, W.C. (2011). Effect of broadband-noise masking on the behavioural response of a harbour porpoise (Phocoena phocoena) to 1-s duration 6–7 kHz sonar up-sweeps," J. Acoust. Soc. Am. 129 (4), 2307–2315 (2011).

55 Kastelein R.A., Steen, N., Gransier, R. and de Jong, C.A.F. (2013a). Brief Behavioural Response Threshold Level of a Harbour Porpoise (Phocoena phocoena) to an Impulsive Sound, Aquat. Mamm. 39, 315–323.

56 Kastelein et al. (2013b). Kastelein R.A., van Heerden D., Gransier R. & Hoek L., (2013b), Behavioral responses of a harbor porpoise (Phocoena phocoena) to playbacks of broadband pile driving sounds. Mar. Environ. Res. 92, 206-214.

57 Marine Scotland (2014). East of Gannet and Montrose Fields Marine Protected Area Order 2014. Available at: http://www.gov.scot/Resource/0045/00457020.pdf.

58 MMO 2015 (2015). Modelled mapping of continuous underwater noise generated by activities. A report produced for the Marine Management Organisation, pp 50. MMO Project No: 1097. ISBN: 978-1-909452-87-9.

59 Nedwell, J.R, J Lowell, and A Turnpenny (2005). Experimental validation of a species-specific behavioral impact metric for underwater noise. Journal of the Acoustical Society of America: 118(3): 2019-2019.

60 Neff, J.M., (2005) Composition, environmental fates, and biological effects of water based drilling muds and cuttings discharged to the marine environment: A synthesis and annotated bibliography. Petroleum Environmental Research Forum (PERF) and American Petroleum Institute.

61 Neff, J.M., Bothner, M.H., Maciolek, N.J., Grassle, J.F., (1989) Impacts of exploratory drilling for oil and gas on the benthic environment of Georges Bank. Marine Environmental Research. 27. 77-114

62 Nicholls et al (2003). Nicholls, P., Hewitt, J and Halliday. J (2003) Effects of suspended sediment concentrations on suspension and deposit feeding

marine macrofauna. Auckland Regional Council. Technical Publication 211. August 2003.

63 OGP (2010). Risk Assessment Data Directory, Report No. 434-17.

64 OGUK (2009). Accident statistics for Offshore Unites on the UKCS 1990-2007. Issue 1. April 2009.

65 OGUK (2011). EEMS Report 2011: Key UK Oil and Gas Industry Environmental Data

66 OGUK (2015). Environment Report 2015. Available at: http://www.oilandgasuk.co.uk/environment-report.cfm.

67 OGUK (2017). Environmental Report Available online: https://cld.bz/QWQ7dwt/42/.

68 OGUK. (2014). Environment Report 2014. Available at: http://cld.bz/dxDq9ju#24.

69 OSPAR (2008). OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR Reference Number: 2008-6). Available from: http://jncc.defra.gov.uk/pdf/08-06e_OSPAR%20List%20species%20and%20habitats.pdf.

70 OSPAR (2009). Assessment of impacts of offshore oil and gas activities in the North-East Atlantic. Available online http://qsr2010.ospar.org/media/assessments/p00453_OA3-BA5_ASSESSMENT.pdf.

71 OSPAR (2007). Assessment of impacts of offshore oil and gas activities in the North-East Atlantic. Available online http://qsr2010.ospar.org/media/assessments/p00453_OA3-BA5_ASSESSMENT.pdf.

72 OSPAR Commission (2000). Quality Status Report 2000, Region II – Greater North Sea.

73 BP (2010). Quad 204 Project Environmental Statement. November 2010.

74 Reid, J.B., Evans, P.G.H. and Northridge, S.P. (2003). Atlas of Cetacean distribution in north-west European waters. Joint Nature Conservation Committee, Peterborough, UK.

75 Richardson, W.J., Thomson, D.H., Green Jr, C.R. and Malme, C.I. (1995). Marine mammals and noise. Academic Press, New York

76 Scottish Natural Heritage (2014). Priority Marine Features in Scotland's seas. http://www.snh.gov.uk/protecting-scotlands-nature/priority-marine-features/priority-marine-features/.

77 Scottish Natural Heritage (2017). Priority Marine Features in Scotland's seas. http://www.snh.gov.uk/protecting-scotlands-nature/priority-marine-features/priority-marine-features/.

78 Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr, C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L. (2007). Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals, Volume 33, Number 4, 2007. Pp 411-509.

79 Spiga, I. (2015). Ocean Acoustics Modelling for EIAs: a Review; http://www.nerc.ac.uk/innovation/activities/infrastructure/offshore/illaria-spiga-review/.

80 Stone, C.J., Webb, A., Barton, C., Ratcliffe, N., Reed, T.C., Tasker, M.L., Camphuysen, C.J. and Pienkowsk M.W. (1995). An atlas of seabird distribution in north-west European waters. 326 pages, A4 softback, ISBN 1 873701 94 2.

81 Thakter, C.B., Lescelles, B., Sugar, K., Cook, A.S.C.P., Roos, S., Bolton, M., Langton, R,H.W & Burton, N.H.K (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. Available online at https://www.researchgate.net/publication/236034521_Seabird_foraging_ranges_as_a_preliminary_tool_for_identifying_candidate_Marine_Protected_Areas.

82 The Scottish Government (2015). Scotland's National Marine Plan. A Single Framework for Managing Our Seas. http://www.gov.scot/Resource/0047/00475466.pdf.

83 The Scottish Government (2017). Fishing effort and quantity and value of landings by ICES Rectangle. 2016 statistics updated in September 2017. http://www.scotland.gov.uk/Topics/Statistics/Browse/Agriculture-Fisheries/RectangleData .

84 TNO (2015). Framework for assessing the ecological and cumulative effects of offshore wind farms: Cumulative effects of impulsive underwater sound on

marine mammals. Report No. TNO 2015 R10335-A Version 1-1.

85 Tougaard J, Buckland S, Robinson S and Southall B (2014). An analysis of potential broad-scale impacts on harbour porpoise from proposed pile driving activities in the North Sea. Report of an expert group convened under the Habitats and Wild Birds Directives – Marine Evidence Group. Unpublished report to Defra.

86 Turrell, W.R. & Bannister, C. (2003). Fisheries Research Services Collaborative Report No 13/03. Ocean Climate in Relation to North Sea Cod. http://www.gov.scot/uploads/documents/1303.pdf.

87 Tyler-Walters, H., James, B., Carruthers, M. (eds.), Wilding, C., Durkin, O., Lacey, C., Philpott, E., Adams, L., Chaniotis, P.D., Wilkes, P.T.V., Seeley, R., Neilly, M., Dargie, J. & Crawford-Avis, O.T. (2016). Descriptions of Scottish Priority Marine Features (PMFs). Scottish Natural Heritage Commissioned Report No. 406.

88 UKMMAS (2010). Charting Progress 2. An assessment of the state of UK seas. http://chartingprogress.defra.gov.uk/report/CP2-OverviewReport-screen.pdf.

89 UKOOA (2002). Drill Cuttings Initiative Final Report. United Kingdom Offshore Operators Association.

90 UKOOA (1999). Industry Guidelines on a Framework for Risk Related Decision Support. Issue 1. May 1999.

91 Webb, A., Elgie, M., Irwin, C., Pollock, C. and Barton, C. (2016). Sensitivity of offshore seabird concentrations to oil pollution around the United Kingdom: Report to Oil & Gas UK. Document No HP00061701.

Wyatt, R. (2008). Review of existing data on underwater sounds produced by the oil and gas industry. Oil and Gas Producers (OGP) Joint Industry Programme report on Sound and Marine Life

APPENDIX A

Policy & Legislation Framework

A.1 POLICY AND LEGISLATION FRAMEWORK

This ES has been prepared to address the requirements of The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017 (S.I. 2017/582) (the “EIA Regulations”).

In addition, other relevant EU, UK and local legislation, policy and agreements have also been considered as part of the impact assessment process. These may require consent or approval in their own right. While the list is not exhaustive, the following sections detail the main policies, laws and guidelines relevant to the activities considered by this ES.

A.1.1 Marine Planning

A.1.1.1 Scottish National Marine Plan

The Scottish National Marine Plan (SNMP) 2015, in accordance with EU Directive 2014/89/EU, introduces a framework for maritime spatial planning across Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles). It also applies to the exercise of both reserved and devolved functions. The SNMP “sets out strategic policies for the sustainable development of Scotland’s marine resources out to 200 nautical miles”.

The development area is located within the region covered by the SNMP and has therefore been assessed against the SNMP general principles (see Table A-1) and the Oil and Gas Marine planning policies (Table A-2).

Table A-1 Vorlich development assessed against SNMP general principles

Scotland National Marine Plan General Planning Principle	Applicable	Assessment
GEN 1 General panning 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.	✓	This development is in favour of sustainable development.
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 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 development is in line with sustainable development & considers other sea users.
GEN 4 Co-existence: Proposals which enable co-existence 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	✓	The development considered other sea users within the decision-making process. Mitigation has been proposed to ensure co-existence is possible.
GEN 5 Climate change: Marine planners and decision makers must act in the way best calculated to mitigate, and adapt to, climate change.	✓	Emissions will be monitored with a view of long-term reductions.
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.	✓	There are no known wrecks or heritage sites the development area.
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.	X	Not applicable
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.	X	Not applicable
GEN 9 Natural heritage: Development and use of the marine environment must:	✓	The potential for impacts on PMFs has been assessed in the EIA. The

Scotland National Marine Plan General Planning Principle	Applicable	Assessment
(a) Comply with legal requirements for protected areas and protected species. (b) Not result in significant impact on the national status of Priority Marine Features (PMFs). (c) Protect and, where appropriate, enhance the health of the marine area.		development complies with points A-C.
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 International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004 requirements.
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.	✓	All vessels are equipped to meet the requirements under the Merchant Shipping Act 2015. Vessels will also comply with The International Convention for the Prevention of Pollution from Ships 1973 (MARPOL 73/78).
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.	✓	The development will not result in deterioration of water quality and appropriate assessments will be undertaken (i.e. chemical risk assessment).
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.	✓	A noise assessment has been undertaken for pilling and mitigation measures have been put in place.
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.	X	Not applicable
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>	X	Not applicable
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.	X	Not applicable.
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 development has been subject to stakeholder engagement. The ES will be subject to public consultation.
GEN 19 Sound evidence: Decision making in the marine environment will be based on sound scientific and socio–economic evidence.	✓	The EIA is based on site specific survey data and scientific literature.
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.	✓	BP management practices are formed on the most recent and sound data and regularly reviewed to ensure compliance with policy.
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 have been assessed as part of the EIA (see Section 7).

Table A-2 Vorlich development assessed against oil and gas marine planning policies

Scotland National Marine Plan General Planning Principle	Applicable	Assessment
OIL & GAS 1: The Scottish Government will work with DECC (now OPRED), 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 Best Available Technology (BAT) and Best Environmental Practice (BEP). Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.	✓	BAT and BEP have been used to inform decision-making for selection of development options and will continue to be used throughout design. This EIA considers the environmental risks associated with the development. Further assessment will be undertaken in the future permit applications e.g. drilling and pipeline EIA Directions, Chemical permits etc.
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	✓	Development option makes use of existing infrastructure as a host facility. Decommissioning will take place in line with best and standard practice.
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.	✓	The development has been designed to minimise seabed footprint e.g. use of drilling template, pipeline running parallel to existing infrastructure, and considered environmental and social-economic constraints.
OIL & GAS 4: All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance	X	Not applicable.
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.	X	Not applicable.
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.	✓	BP will have approved emergency response plans in place ahead of any field activities.

A.1.1.2 Marine Strategy Framework Directive

The aim of the European Union's Marine Strategy Framework Directive (MSFD) (2008/56/EC) is to protect more effectively the marine environment across Europe. The Marine Directive was adopted by the EU on 15th July 2008 and transposed into Scottish legislation by the Marine (Scotland) Act 2010. The Commission produced a set of detailed criteria and methodological standards to help Member States implement the Marine Directive. These were revised in 2017 leading to the new Commission Decision on Good Environmental Status. The MSFD outlines 11 high level descriptors of GES in Annex I of the Directive. The Vorlich development is aligned with all these descriptors.

A.1.2 Strategic and Environmental Impact Assessment

A.1.2.1 Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (SEA Directive)

The SEA Directive applies to a range of public plans and programmes, both offshore and onshore, including energy. Under the Directive it is mandatory for plans and programmes to be prepared for agriculture, forestry, fisheries, energy, industry, transport, waste/water management, telecommunications, tourism, town & country planning or land use. These must set the framework for future development consent of projects listed in the EIA Directive; or have been determined to require an assessment under the Habitats Directive (EC Directive 1992/43/EC).

In the UK the SEA Directive is implemented through the Environmental Assessment of Plans and Programmes Regulations 2004. Although the SEA Directive was not incorporated into UK law until 2004, SEAs have been carried out by the Department for Business Energy & Industrial Strategy (BEIS) (formerly DTI, BERR and DECC) since 1999. BEIS and its predecessors undertook a sequence of oil and gas SEAs considering various areas of the UKCS (SEA areas 1 – 8). More recently offshore energy SEA (OESEA, OESEA2, OESEA3) consider the entire UKCS for oil and gas and renewable energy.

The development area lies within Regional Sea 1 according to the OESEAs.

A.1.2.2 The Offshore Petroleum Production and Pipe-lines (Environmental Impact Assessment and other Miscellaneous Provisions) (Amendment) Regulations 2017

Under these regulations consent is required for offshore hydrocarbon-related activities. Consent is granted by the Oil and Gas Authority (OGA) but is also subject to agreement by the Secretary of State. There are criteria which outline activities that do and do not require submission of an ES. If an ES is required the activity involves the extraction of hydrocarbons for commercial purposes >500 tonnes/day (oil)/500,000m^3/day (gas); pipelines of >800mm diameter and >40km in length; geological storage of CO_2; or installation for the capture of CO_2.

As the Vorlich field will involve the extraction of >500 tonnes of oil per day it is necessary to submit an ES to support the consent application.

Post-submission of the ES, any changes that do not exceed the thresholds listed above can be sought within an EIA Direction.

BEIS provide guidance on the content of ESs prepared under the Regulations. The latest guidance (dated September 2017) has been used to inform this ES.

A.1.3 Protected species and sites

Areas or species designated for protection under the Habitats Directive (EC Directive 1992/43/EC on the conservation of natural habitats and of wild fauna and flora as amended by Council Directive 97/62/EC) or the Wild Birds Directive (EC Directive 2009/147/EC on the conservation of wild birds) are required to be considered in an EIA to determine possible impacts posed by the proposed activity. The Directives are transposed into UK legislation through the following regulations.

A.1.3.1 The Offshore Petroleum Activities (Conservation of Habitats) Amendment Regulations 2007

The regulations apply the Habitats and Birds Directives to oil and gas projects on the UKCS. They require the Secretary of State undertakes a Habitats Regulation Assessment (Appropriate Assessment) if the proposed activities, whether on their own or in combination with any other plan or project, are likely to have a significant effect on a Natura 2000 site (i.e. Special Area of Conservation, Special Protection Area). In addition, UK Government policy (ODPM Circular 06/2005) states that sites designated under the Convention on Wetlands (Ramsar, Iran 1971) known as the "Ramsar Convention" are also included under the definition Natura 2000. The appropriate assessment is carried out against the sites conservation objectives.

It is not envisaged that the Vorlich development will require an appropriate assessment as it is not located within a protected site. There are two protected sites located within a 40km radius of the development area; the East of Gannet and Montrose Fields NCMPA 29km to the west and the Fulmar MCZ 29km to the south. This EIA has identified that these sites are suitably distant and that there will not be significant effects resulting from the development of Vorlich.

A.1.3.2 The Conservation of Offshore Marine Habitats and Species Regulations 2017

The Regulations apply the Habitats and Birds Directive in the UK offshore area (12 nautical mile limit to the end of the Exclusive Economic Zone) and aim to protect marine species and birds by preventing environmentally damaging activities. They create offences that ensure certain activities in the offshore marine environment can be managed.

Of particular note to the proposed development is that the regulations make it an offence to deliberately disturb wild animals of a European Protected Species in such a way as to be likely (a) to impair their ability (i) to survive, breed, or rear or nurture their young; or (ii) in the case of animals of a hibernating or migratory species, to hibernate or migrate or b) to affect significantly the local distribution or abundance of that species. Assessment of the generation of underwater noise from project activities is included in Section 5.4.

A.1.3.3 Convention for the Protection of the Marine Environment of the North East Atlantic (Oslo Paris Convention) (OSPAR) 1992

This is the main legislative instrument regulating international cooperation, concentrating on provisions to protect the marine environment through the use of best available techniques, best environmental practice and where appropriate clean technologies.

The OSPAR Biological Diversity and Ecosystems Strategy sets out that the OSPAR Commission will assess which species and habitats need to be protected. The OSPAR List of Threatened and/or Declining Species and Habitats has been developed to fulfil this commitment. The list includes (but is not limited to) ocean quahog; dog whelk; flat oyster; lesser black-backed gull; black-legged kittiwake; Roseate tern; European eel; basking shark; common skate; spotted ray; cod; sea lamprey; thornback skate / ray; salmon; harbour porpoise; deep-sea sponge aggregations; maerl beds; blue mussel beds; S*abellaria spinulosa* reefs; and sea-pen and burrowing megafauna communities.

Species that appear on the list that are found within the development area have been identified within the environmental baseline (Section 5).

A.1.3.4 UK Post-2010 Biodiversity Framework

The UK biodiversity action plan (UK BAP) was the UK Government's initial response to the international treaty, Convention on Biological Diversity 1992 (which set out commitments for maintaining the world's ecological biodiversity). The UK's initial response described the biological resources and provided detailed plans for the protection of these resources. It listed priority species and habitats that were identified as being the most threatened and required conservation action under the UK BAP.

In July 2012 the UK Post-2010 Biodiversity Framework was published, succeeding the UK BAP. Much of the work carried out under the UK BAP is now focused at a country level, e.g., England, Wales, Scotland and Northern Ireland. The resources collated under the UK BAP were used to draw up statutory lists of priority species and habitats. The framework sets out the priorities for UK-level work to support the CBD's Strategic Plan for Biodiversity 2011-2020 and its five strategic goals and 20 'Aichi Biodiversity Targets' (agreed October 2010), and the EU Biodiversity Strategy (launched May 2011). It shows how the work of the four UK countries work at a UK level to achieve the biodiversity targets and strategy, and how this work is to be implemented and provides for annual reporting on progress.

UK BAP species are identified and considered within the environmental baseline and EIA of this ES (see Section 4 and 5).

A.1.3.5 Scottish Priority Marine Features

The Scottish Government has committed to maintaining a healthy and biologically diverse marine and coastal environment. The Marine (Scotland) Act 2010 included new powers and duties to help deliver this aspiration. To help target marine nature conservation measures Scottish Natural Heritage and the Joint Nature Conservation Committee have generated a focused list of habitats and species of importance – the PMFs (Tyler-Walters et al. 2016)

PMFs were identified through a scientific evaluation of Scotland's known marine biodiversity interests and include broad habitats; low or limited mobility species; and mobile species. 81 habitats and species are currently included on the list (Tyler-Walters et al. 2016).

PMFs present in the development area have been identified in the environmental baseline description (Section 4) and potential impacts assessed in Section 5.

A.1.4 Atmospheric emissions

A.1.4.1 Greenhouse Gas Emissions Trading Scheme (Amendment) Regulations 2017

The regulations (S.I. 2017 No 1207) implement the EU Emissions Trading Scheme (EU-ETS) Directive (2003/87/EC) in the UK. This establishes a scheme for greenhouse gas emissions trading. The regulations require that an installation with a combustion plant that on its own or in aggregate with another combustion plant of a rated thermal input exceeding 20MW (th) must be registered under the EU-ETS. Vorlich development comprises of a subsea infrastructure tied back to an existing producing installation. Therefore the Vorlich development does not require registration under the EU-ETS.

A.1.4.2 Energy Act 1976 and Petroleum Act 1998

These act govern the flaring and venting of both hydrocarbon and insert gas from licensed areas. Consents to vent area required for all Category 4 (unignited vents). Appropriate consents will be sought to cover flaring activities during the drilling phase of the development at Vorlich. Any additional flaring and venting required during the production phase will be incorporated as revisions to the existing consents for production from the FPF-1.

A.1.5 Chemical discharges

A.1.5.1 Offshore Chemical (Amendment) Regulations 2011

Amending the 2002 regulations of the same name, these regulations apply the OSPAR Convention 2000/2 decision to implement a harmonised mandatory control system for the use and discharge of chemicals by the offshore oil and gas industry. Under these regulations BP are required to apply to the Secretary of State for a Chemical Permit to cover the use and discharge of chemicals during all offshore oil and gas activities. Permits for activities such as drilling wells; pipeline operations; maintenance activities (e.g. well interventions); production; and decommissioning, will be submitted via the Energy Portal Environmental Tracking System.

A.1.6 Hydrocarbon and produced water discharges

A.1.6.1 Convention for the Protection of the Marine Environment of the North East Atlantic (Oslo Paris Convention) (OSPAR) 1992

This is the main legislative instrument regulating international cooperation. It concentrates on provisions to protect the marine environment through the use of best available techniques, best environmental practice and where appropriate clean technologies.

OSPAR Recommendation 2012/5 requires member states to implement a risk-based approach for the management of produced water discharges from offshore installations (referred to as RBA). The approach is a method of prioritising mitigation actions on those discharges and substances that pose the greatest risk to the environment. All UK offshore installations that have a permit to discharge produced water are included in the UK implementation programme. RBA will be required for the FPF-1 produced water discharges. There is no produced water discharge stream from the Vorlich development.

A.1.6.2 The Offshore Petroleum Activities (Oil Pollution Prevention and Control) (Amendment) Regulations 2011

The OPPC Regulations are designed to encourage operators to reduce the quantities of hydrocarbons discharged during offshore operations. Discharges to sea are prohibited unless in strict accordance of the terms of an Oil Discharge Permit. Operators must identify all planned oil discharges to relevant waters and apply for the appropriate permits ahead of activities commencing. Term permits (permits restricted by date) will be sought to cover any necessary hydrocarbon discharges during drilling and pipeline installation activities.

A.1.7 Transboundary

A.1.7.1 Convention on Environmental Impact Assessment in a Transboundary Context (Espoo) 1991

The Convention lays down a general obligation to States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries. Modelling of a worst-case oil release scenario at Vorlich identified that in the unlikely event of a well blowout, it is likely that oil will cross the UK median line and enter other territories waters (see Section 6). It will be necessary to address the need for international cooperation in response to this event. This will be outlined in the OPEP.

A.1.8 Un-planned events

A.1.8.1 International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) 1995

The Convention on OPRC primary objectives are to facilitate international cooperation and mutual assistance in preparation for and responding to a marine pollution event.

Parties to the OPRC are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries. Ships and operators of offshore installations are required to have an oil pollution emergency plan (OPEP) or similar arrangements which must be co-ordinated with national systems for responding promptly and effectively to oil pollution incidents. In the UKs obligations under the Convention are transposed into legislation by the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015.

A.1.8.2 The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) (Amendment) Regulations 2015

The OPRC Regulations, implement the provisions of the Offshore Safety Directive (2013/30/EU) relating to the oil pollution aspects of internal emergency responses plans. They require all Operators of offshore oil and gas installations and pipelines to have an approved oil pollution emergency plan

(OPEP) in place before activities commence. The OPEP sets out arrangements for responding to incidents which cause or may cause marine pollution by oil, with a view to preventing such oil pollution or reducing or minimising effect. An OPEP will be prepared and submitted to BEIS prior to commencement of activities at Vorlich. This will include reference to international cooperation arrangements.

A.1.8.3 Offshore Installations (Emergency Pollution Control) Regulations 2002

The EPC Regulations give the Government power to intervene in the event of an incident involving an offshore installation where there is or there may be a risk of significant pollution, or where an operator has failed to implement proper control and preventative measures. These Regulations apply to chemical and oil spills.

A.1.8.4 Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015

These Regulations, together with the OPRC regulations, implement the Offshore Safety Directive. They are intended to provide for management and control of major accident hazards and environmental incidents arising from major accidents. The regulations establish the Offshore Safety Directive Regulator (OSDR) as Competent Authority. They act to integrate safety and environmental protection within an operation safety case.

A.1.9 Other licensing requirements

A.1.9.1 Marine and Coastal Access Act 2009

The Act has introduced a marine licensing system that covers offshore activities which are the responsibility of OPRED but which are not currently controlled under the Petroleum Act 1998, the Energy Act 2008 or exempted under the Marine Licensing (Exempted Activities) (Amendment) Order 2013. Generally, this relates to decommissioning activities, the depositing or removal of materials and the use of explosives. All activities to be undertaken during the Vorlich development discussed in this ES are covered by the Petroleum Act 1998 and it is unlikely that a Marine Licence will be required.

APPENDIX B

Schematics

B.1 SCHEMATICS

Figure B-1 Representative well schematic

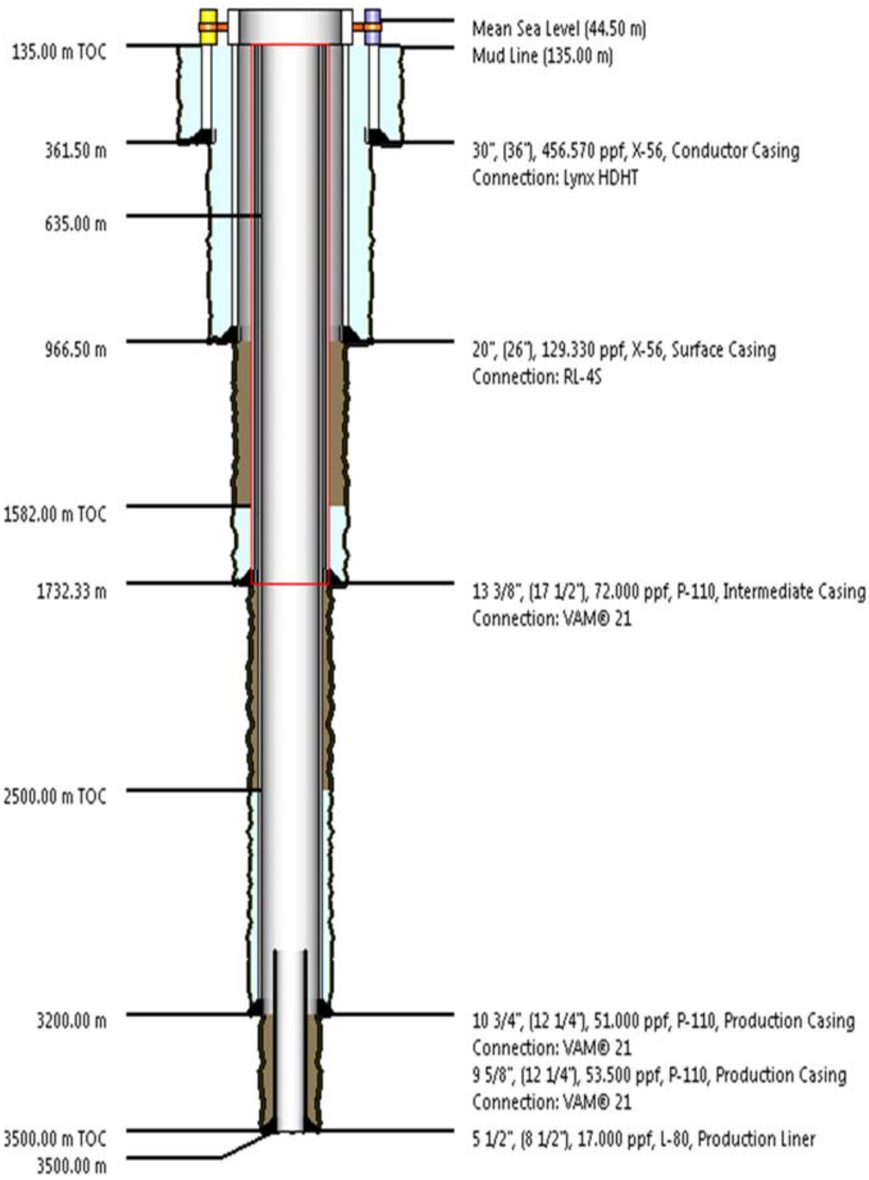
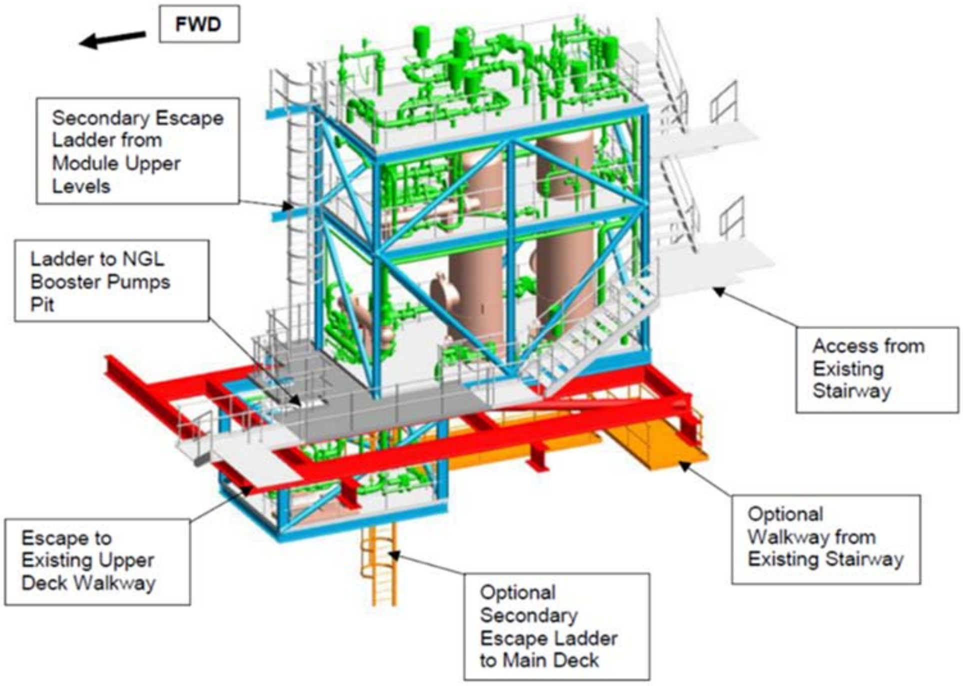
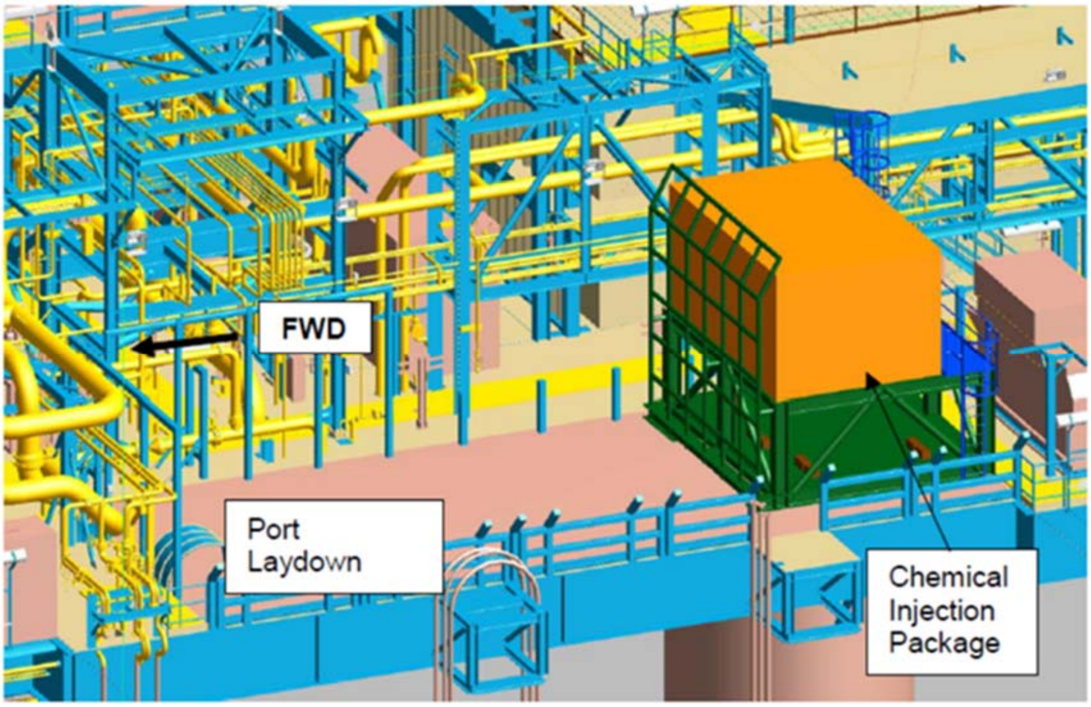


Figure B-2 New NGL plant layout



NGL=Natural gas liquid; FWD= forward

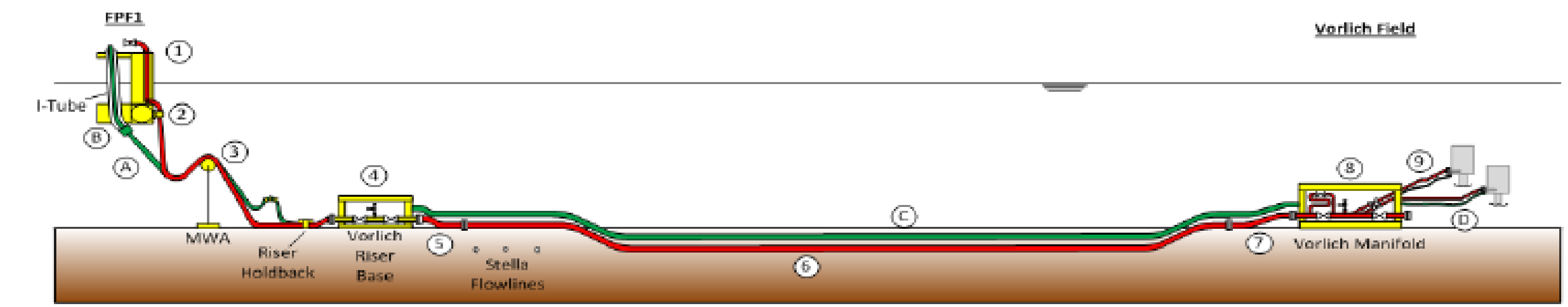
Figure B-3 Chemical injection package



FWD = forward

Figure B-4 Vorlich to FPF-1 subsea system

Vorlich to FPF1 Subsea System



Production System	1 Rigid Riser	2 Riser Connector	3 Dynamic Riser	4 Riser Base	5 Spoolpiece	6 Pipeline	7 Spoolpiece	8 Manifold	9 Spools (2No)
Design Pressure	421 barg [7]		3,150psi (217 barg) [1]						
Design Temp. – Max	+115ºC [7]		+90ºC [7]	115ºC [1]					
Design Temp – Min	-30ºC [7]		-30ºC [3]					-46ºC [5]	-70ºC [5]
Diameter	10" NB [7]	10" NB [7]	8" ID [2]	8" NB	8" NB [2]	8"/12" PIP [2]	8" NB [2]	8" /6" NB [2]	6" NB
Length	75m	1m	400m	8m	50m	9,753m [6][7]	50m	10m plus 60m WUS	50m
Material	25% Cr [7]	3mm 625 clad Carbon Steel [7]	316L Carcass [7]	25% Cr [4]	25% Cr [4]	13%Cr [4]	25% Cr [4]	25% Cr [4]	25% Cr [4]
Insulation	12mm EPDM	Free Draining	2.5W/m²K	Free Draining	2.5W/m²K	1.0W/m²K	2.5W/m²K	Free Draining	2.0W/m²K
Structure Type	-	-	-	Gravity Base [8]				Piled Fisherman Friendly [8]	

Umbilical	A Dynamic Umbilical	B Umbilical BSC	C Static Umbilical	D Tree Jumpers
Details	LP (4 x ½"); HP (2 x ⅜"); Methanol (2 x 1"); WI (1 x ¾"); LDHI (1 x ¾"); SSIV LP (2 x ½"); Spare (3 x ¾"); Power Quad (3kV) (1 x 10 mm²); Signal Quads (3 x 10 mm²); SSIV (2 x 2.5mm²) [4]	25" Diverless Bend Stiffener Connector – Male & Female Halves	LP (4 x ½"); HP (2 x ⅝"); Methanol (2 x 1"); WI (1 x ¾"); LDHI (1 x ¾"); Spare (3 x ¾"); Power Quad (3kV) (1 x 10 mm²); Signal Quads (3 x 10 mm²) [4]	7-way HFL and CFL Bundle EFL (2 x 2.5 mm² - Channel A & Channel B)
Length	400m	n/a	9,855m [2]	60m

BP References

[1]	Study Basis for Concept Screening, Doc. No. J10356-VXX-RD-X-00100, Rev 3, Granherne.	[2]	Flow Assurance Report – Vorlich to Stella, Doc. No. NS024-FL-REP-029-00001, Rev B02.
[3]	Inferred from the limit on 13% Cr presented as pipeline material in Ref. [4].	[4]	Presentation – BP & Ithaca Vorlich Facilities Meeting, 10 August 2016.
[5]	Basis assumed based on predicted minimum of -50ºC presented in Ref [4].	[6]	Presentation - Vorlich – Wells Overview, 29th September 2016 (Well Tophole location used as basis for pipeline routing)

Ithaca References

[7]	Tie-Back to Stella FPF1 – Technical Basis, Doc No. VOR-SF-IT-PL-RE-0001, Rev A2, Ithaca Energy	[8]	Stella Subsea Detailed Design – Design Basis, Doc. No. STE-SF-PA-MD-BD-0002, Rev C2.

Figure B-5 Mid water arch (MWA) to holdback structure – schematic view

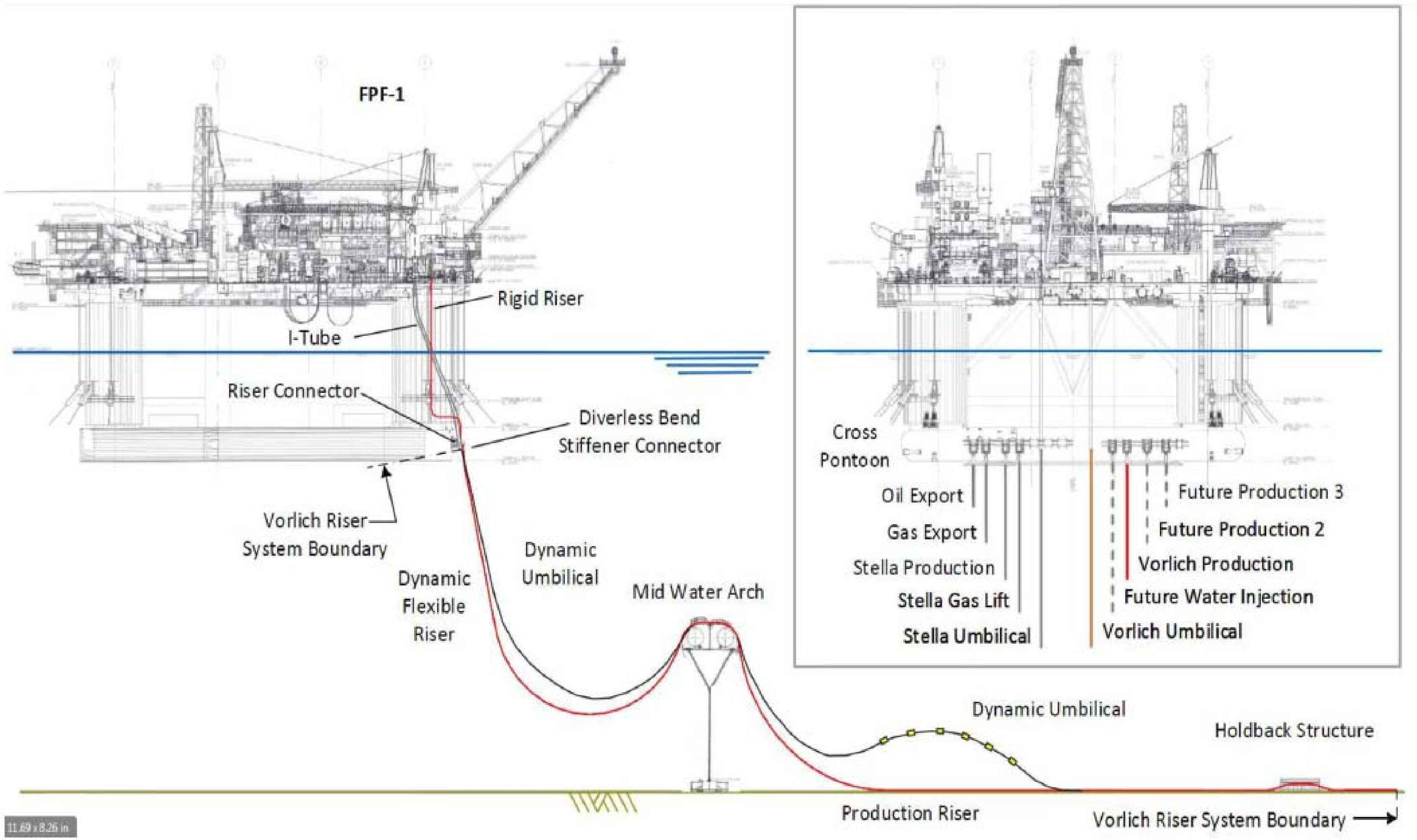


Figure B-6 Vorlich pipeline and umbilical riser interfaces

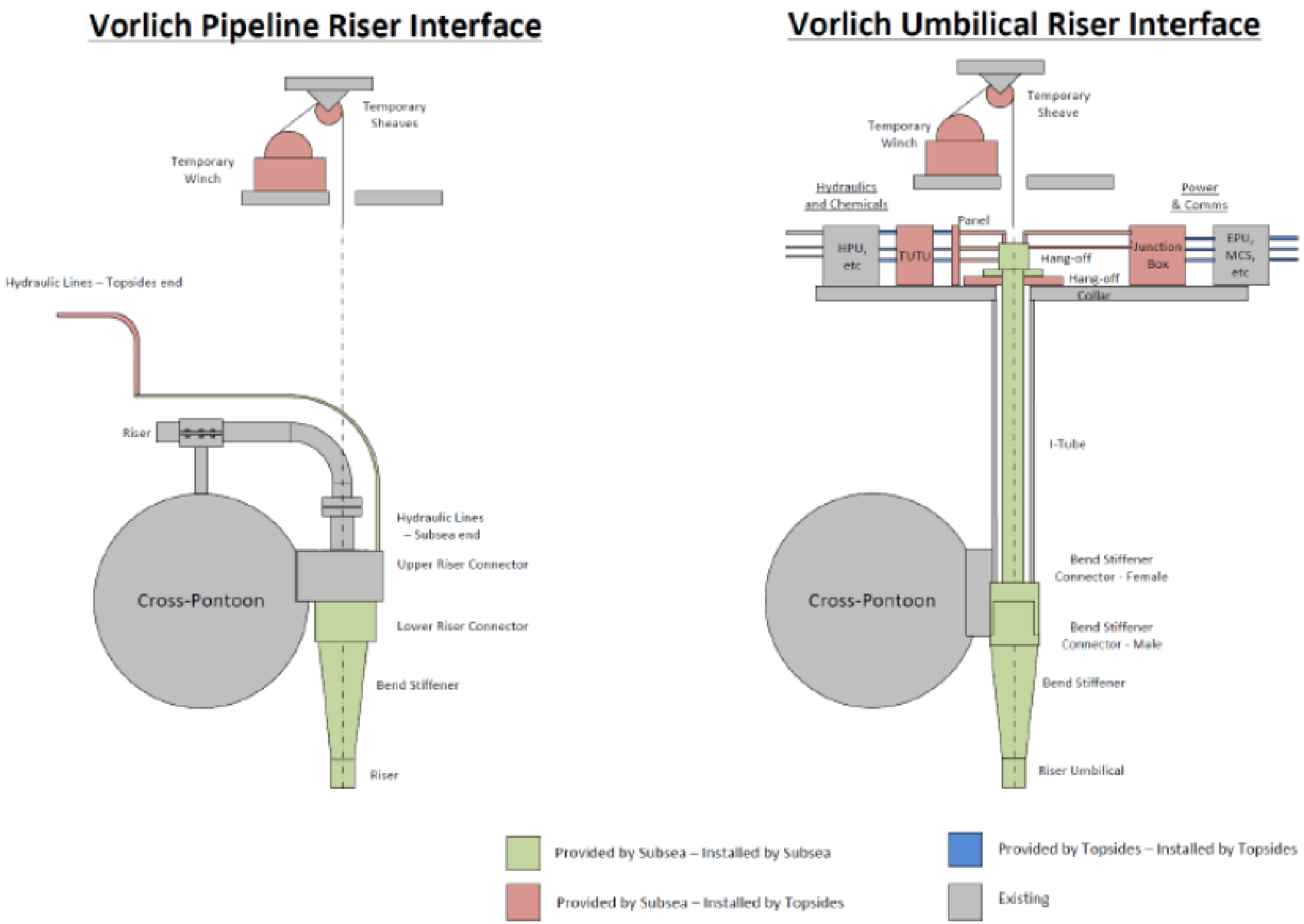


Figure B-7 Vorlich Field Development Infield Layout

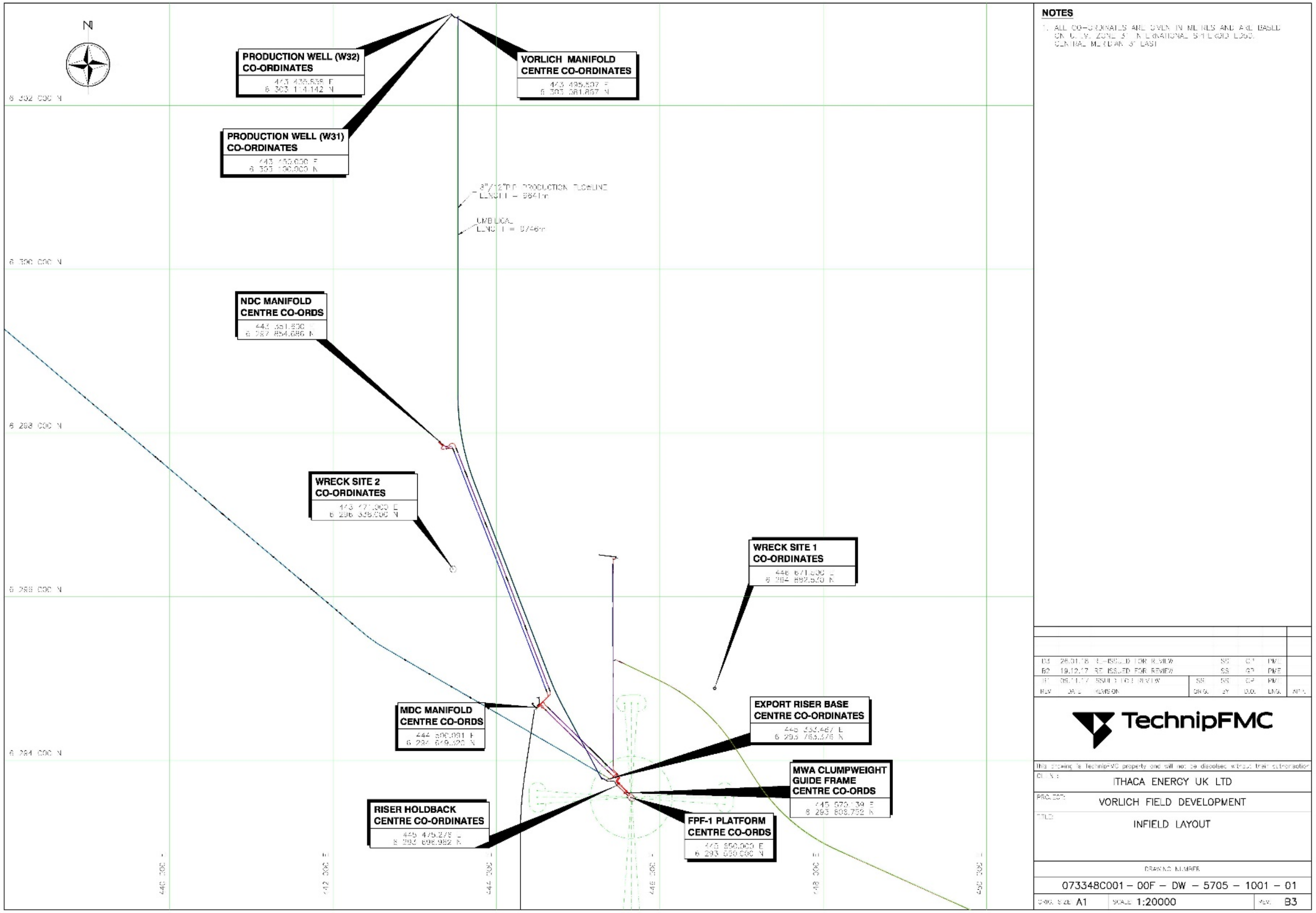


Figure B-8 Vorlich Field Development Approaches at Drill Set

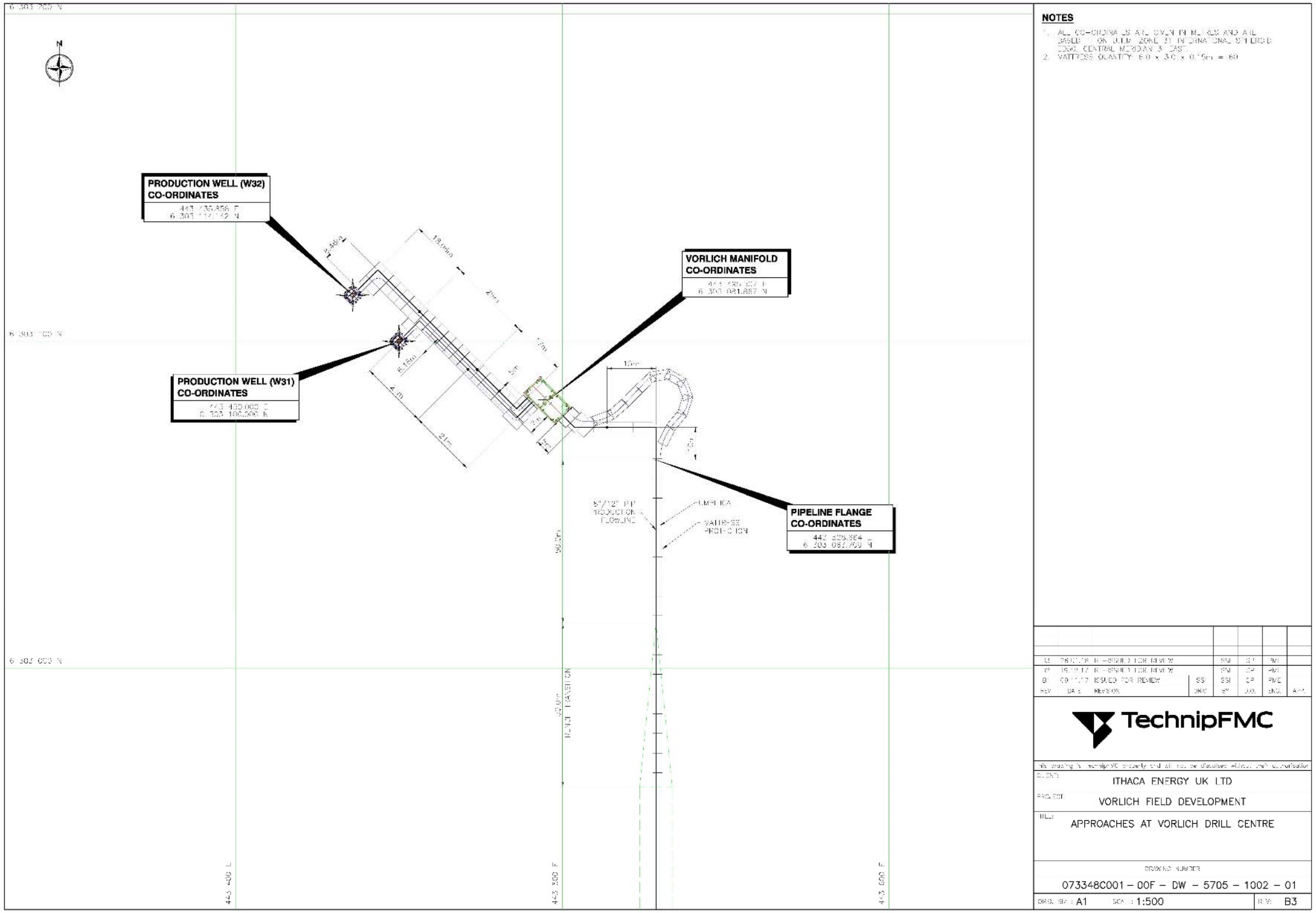
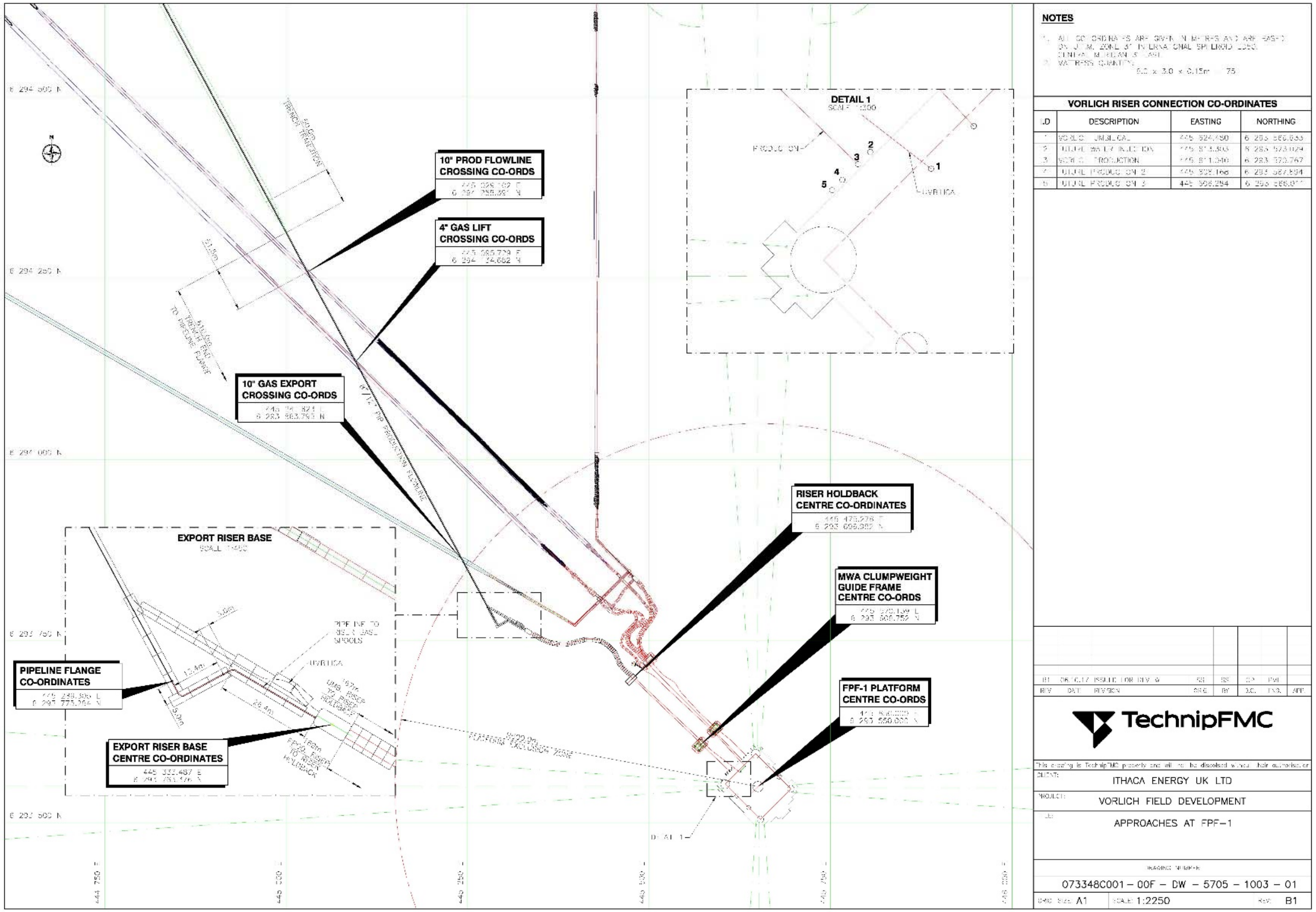


Figure B-9 Vorlich Field Development Approaches at FPF-1



APPENDIX C

Consultation

C.1 STAKEHOLDER MEETING MINUTES

A stakeholder meeting was held between BP and the Department for Business, Energy and Industrial Strategy (BEIS); Joint Nature Conservation Committee (JNCC); Scottish Fishermen's Federation (SFF); and Marine Scotland (MS) on 31 January 2018 to discuss the Vorlich development. Meeting minutes are provided below.

Time	0900-1100		
Date	31st January 2018		
Location	BP North Sea HQ Office, 1-4 Wellheads Avenue, Dyce, AB21 7PB		
Attendees	BP	-	Clare Sloan Tom Hardinges Ross Nickson Peter Haw
	BEIS	-	Nienke Mayo
	JNCC	-	Rosanne Dinsdale
	SFF	-	Raymond Hall Stephen Alexander
	MS	-	Daniel Stewart

Summary

The BP NS (North Sea) Projects Update Stakeholders meeting was set up to communicate the status of projects within the North Sea and the status of new developments. In particular the focus was on the Alligin and Vorlich subsea tie-back projects which will be subject to submission of Environmental Statements in Q1 2018. A copy of the presentation given was distributed to attendees post-meeting.

Points made in relation to Vorlich:

Vorlich:

1. BP confirmed that Vorlich pipelines will be trenched and buried.
2. BEIS requested that Vorlich oil spill modelling considers the FPF1 OPEP/Safety Case and aligns with the modelling assumptions. BP agreed to look into this.

General:

1. BEIS pointed out that the ES submission process has increased from 28 to 30 days public notice that begins at point of the application receiving acknowledgement of receipt from BEIS. Furthermore, at point of submission 2 hard copies and an electronic copy should be provided along with a submission summary providing a competency assessment of the individuals (authors) of the Environmental Statement.

Question	Answer
Will the manifolds and mid water arch, which are being piled, be easily removed at end of use?	BP to confirm with Ithaca.
What are the Environmental Statement submission timetables for Alligin and Vorlich?	Vorlich license expiring in September 2018. Plan is to submit the Vorlich Environmental Statement by End February.

Once the pipelines are trenched and buried will there be any other snagging risks (for example fishing gates)? In addition will there be a post installation survey to confirm?	BP to review whether a post installation survey is planned after trenching and burial.
What are the sizes of the Vorlich pipelines and will they be placed within a common trench?	BP provided sizes and confirmed that they will be in a common trench.
Actions in relation to Vorlich	
1. BP to organise a follow up meeting with JNCC to discuss Habitats Assessment results when they become available. 2. Marine Scotland offered to share new layers produced as part of the National Marine Plan, along with updated cod/haddock/whiting data.	

C.1.1 Correspondence between BEIS AND BP

BP contacted BEIS on the 26th January 2018 to ask for guidance on whether it would be possible to submit the ES without the Vorlich Environmental Baseline Survey results. BEIS advised that they were comfortable with the Vorlich ES being submitted without the full environmental survey results on the basis that the results are referenced in later permits, but the final decision/determination will always depend on the assessment provided by the operator.

C.1.2 Actions addressed in EIA

The following table outlines how the actions raised in consultations have been addressed within the EIA.

Source of action	Action	Response
Meeting held on 31/01/18	1. BP to organise a follow up meeting with JNCC to discuss Habitats Assessment results when they become available.	Response to this action is currently pending. EBS will not be available at the time of the submission of the Vorlich ES. This has been discussed with BEIS (see A.1.1 above). When the EBS is available BP will complete their response to this action.
	2. Marine Scotland offered to share new layers produced as part of the National Marine Plan, along with updated cod/haddock/whiting data.	While the new layers are not currently available, the papers associated with the data have been acquired and referenced in the ES.

APPENDIX D

BP HSE Policy

A.2 BP HSE POLICY

Figure D-1 BP HSE Policy

BP North Sea UK HSSE Policy

BP's commitment to **health, safety, security** and **environmental** (HSSE) performance

bp

Our HSSE goals are simply stated:
No accidents, no harm to people and no damage to the environment.

We strive to be a safety leader in our industry, a world-class operator, a good corporate citizen and a great employer. Nothing is more important to us than the health, safety and security of our workforce and the communities in which we operate, and behaving responsibly towards our shared environment. We must be vigilant, disciplined and always looking out for one another. We are committed to:

- Complying with applicable laws and company policies and procedures
- Systematically managing our operating activities and risks
- Reporting and improving our HSSE performance
- Learning from internal and external HSSE events

Everyone who works for BP has a part to play in meeting our HSSE commitment and working safely is a legal requirement and condition of employment. We expect all staff and contractors on BP-operated sites to comply with all applicable legislation, BP requirements, policies, practices, standards, rules and procedures.

We expect all staff and contractors to stop work when there is an unsafe act or behaviour, noncompliance with legislation or when unable to meet BP requirements.

These expectations exist to protect us, the environment and to safeguard the integrity of our operations. Failure to comply with these expectations could result in disciplinary action.

Our Operating Management System (OMS) sets out how we systematically achieve these goals.

Mark Thomas
Regional President - North Sea
1st June 2016

NS-REC-1.2-0001

Figure D-2 Ithaca HSE Policy

ITHACA
ENERGY (UK) LTD.

HEALTH, SAFETYAND ENVIRONMENTAL POLICY

ITHACA ENERGY (UK) LTD. is committed to proactively achieving excellence in Health, Safety and Environmental (HS&E) performance across all of our operations. We consider our HS&E performance and the health, safety and security of those who work for, with and alongside us as central to our business success.

ITHACA will comply with applicable legislation and guidance.

In order to meet our commitment ITHACA will:

- Provide competent resource to implement this policy and to develop and maintain our HS&E systems.
- Provide effective leadership, training and mentoring to sustain and develop workforce HS&E competency and skills and maintain a positive HS&E culture.
- Define clear responsibilities and accountabilities for HS&E issues within the company.
- Set realistic HS&E objectives and tagets and develop action plans to measure these as a contribution towards continual improvement of our HS&E performance.
- Ensure HS&E performance is prominent in the selection of our contractors
- Assess and manage operations through all stages to minimise risk of harm to people, the environment and facilities
- Communicate and consult with stakeholders and the public and have regard for their interests when planning activities.
- Ensure that appropriate plans and resources are in place to respond to incidents and emergencies.
- Investigate incidents, implement recommendations to prevent re-occurrence and share lessons learned.

To support our commitment to HS&E performance ITHACA will develop and maintain effective HS&E systems which will be independently verified against relevant ISO and other recognised standards. HS&E systems will be subject to periodic and management review to ensure ongoing compliance and improvement.

This policy applies to all company activities and ITHACA employees, and contractors and other associates engaged in work on our behalf, have a responsibility to comply with it and prevent harm to themselves and others and damage to the environment.

Les Thomas, CEO ITHACA ENERGY (UK) LTD
On behalf of the Board of Directors

12th March 2016

bp

[redacted]

BP Exploration Operating Company Ltd.
1-4 Wellheads Avenue
Dyce
Aberdeen
AB21 7PB
[redacted]

Claire Grant
OGA Consents and Authorisations Manager
AB1, Second Floor
48 Huntly Street
Aberdeen
AB10 1SH

3 April 2018

Dear Madam,

PETROLEUM PRODUCTION LICENCE(S) P.363 & P.1588: VORLICH FIELD DEVELOPMENT PLAN

I refer to the above-mentioned Petroleum Production Licence(s) and the potential field development mentioned above.

Subject to the necessary management and partner approvals, BP Exploration Operating Company Limited would intend to apply for Consent for the development of the said field, and this letter of application to provide preliminary notification of the proposals is made on behalf of:

Licence P.363
BP Exploration Operating Company Limited (Operator, 80% Equity)
Ithaca Energy (UK) Limited (20% Equity)

Licence P.1588
Ithaca Energy (UK) Limited (Operator, 100% Equity)

The primary nature of this project will be for the development of the Vorlich field as a sub-sea tieback to the existing FPF-1 floating production facility and it is proposed this project will comprise of the following:

- A new two production well, natural depletion, sub-sea tie-back to the existing Ithaca Energy (UK) operated floating production facility, FPF-1. The Vorlich drill centre will be located in UKCS block 30/1c at a water depth of approximately 90m, 10km north of FPF-1 (UKCS block 30/6a) and 241km from the nearest UK coastline in Scotland. The nearest international median line is the UK/Norway median line at a distance of 23km.

- FPF-1 is a spread moored semi-submersible floating production facility equipped to provide oil and gas processing and conditioning. Hydrocarbon liquids are exported from FPF-1 to shore via the Norpipe Oil system and hydrocarbon gas via the Central Area Transmission System (CATS). Oil and gas is further processed onshore and sold to market. FPF-1 is currently host to the Stella field, with the newly developed Harrier field expected to come online later this year.

- Subsea facilities will be installed to gather fluids from the two Vorlich production wells to a cluster manifold before onward transportation to FPF-1 via a dedicated 8-inch in field flow line. The flow line will terminate at a riser base structure with a new flexible production riser connecting to an existing spare riser on the FPF-1 hull. Drill centre services will be provided by an electro-hydraulic umbilical laid along the same flow line corridor.

- Vorlich fluids will be routed through dedicated reception facilities and metered before co-mingling with other FPF-1 fluids for processing and export. A new Natural Gas Liquids (NGL) module will be installed on FPF-1 alongside a number of other minor modifications.

- Drilling of the Vorlich production wells is anticipated to take approximately 6 months and will be undertaken during the summer of 2019. Subsea facility installation and topsides construction activity will commence in spring/summer 2019 and is expected to be complete by autumn 2020 to support first production.

- Vorlich field life is anticipated to be 10 years.

BP Exploration Operating Company Limited can confirm that an Environmental Statement ("ES") for the potential development will be submitted to the Environmental Management Team at the Offshore Petroleum Regulator for Environment and Decommissioning ("OPRED") in their capacity as environmental regulator acting on behalf of the Secretary of State for Business, Energy and Industrial Strategy.

Yours faithfully,

[redacted]

Cc: Environmental Management Team, OPRED (by e-mail to bst@beis.gov.uk)

Offshore Petroleum Regulator
for Environment & Decommissioning

D/4209/2018

Department for Business, Energy & Industrial Strategy

Offshore Petroleum Regulator
for Environment and
Decommissioning
AB1 Building
Wing C
Crimon Place
Aberdeen
AB10 1BJ

Tel +44 (0)1224 254148

www.beis.gov.uk
EMT@beis.gov.uk

Ms Clare Sloan
BP Exploration Operating Company Ltd

[redacted]

4th April 2018

Dear Ms Sloan

THE OFFSHORE PETROLEUM PRODUCTION AND PIPE-LINES (ASSESSMENT OF ENVIRONMENTAL EFFECTS) REGULATIONS 1999 (AS AMENDED) - THE OFFSHORE EIA REGULATIONS

VORLICH FIELD DEVELOPMENT

I acknowledge receipt of two hard copies and an electronic copy of the Environmental Statement (ES) submitted in support of your letter of application to the Oil and Gas Authority in relation to the above project. The Department's reference number for your submission is D/4209/2018, and this number should be quoted in all future correspondence relating to the ES.

I enclose a notice given under regulation 9(1) of the Offshore EIA Regulations which identifies the authorities likely to be interested in the project and upon whom you must serve a copy of the notice, a copy of the letter of application submitted to the Oil and Gas Authority and a copy of the ES. The notice confirms that you must also state that representations may be made to the Secretary of State by the date specified in the notice, which must be at least 30 days from the date on which the documents were served on that authority. Where e-mail contact details are provided in addition to the authorities' postal addresses, you may wish to contact the relevant authority to confirm the preferred format for transmission of the information. Once the documents have been served, confirmation of service and the date of service must be sent to the Environmental Management Team (EMT) at the address or e-mail address shown on this letter.

Regulation 9(2)(f) of the Offshore EIA Regulations requires you to publish a notice containing the information set out in that sub-paragraph, and regulation 9(2A) requires you to publish the notice in such newspapers as to be likely to come to the attention of those interested in, or affected by, the proposals. As a minimum, the advertisements must be published in a newspaper with national circulation and a newspaper with local circulation in the area adjacent to the proposed activity. The Secretary of State hereby directs that such notice shall be published in 'The Telegraph' and 'The Aberdeen Press and Journal', although you may also choose to publish the notice in additional newspapers. A recommended form of the text of the public notice advertisement is annexed to this letter. Regulation 9(2A) also requires that this notice, the letter of application submitted to the Oil and Gas Authority and the ES are published on a public website.

Following publication of the notice, a copy of the letter of application submitted to the Oil and Gas Authority and the ES must be made available for public inspection between the hours of 10 a.m. and 4 p.m. on business days for a period of not less than 30 days, at an address within the United Kingdom that has regard to the whereabouts of any persons likely to interested in, or affected by, the project. Provision must also be made to supply a copy of the ES to any person requesting a copy during that 30 day period, subject to a discretionary charge of £2, as soon as reasonably practicable after receipt of the request.

Following publication of the notice, confirmation of publication (names of newspapers and dates of publication) and copies of the original newspaper advertisements (please provide hard or scanned copies of the relevant pages, where possible to include the names of the newspapers and the dates of publication) must also be sent to EMT at the address or e-mail address shown on this letter. You must also provide a link to the public website on which the items are published. If the Department receives any requests for copies of the ES subsequent to publication of the notice, it will forward you details so that you can provide the requested copies as soon as reasonably practicable following receipt of the requests.

It is your responsibility to ensure that you have fully complied with the requirements of regulation 9 of the Offshore EIA Regulations, and failure to comply with any of the additional requirements detailed in this letter could delay our consideration of the ES.

Yours sincerely

CThomson

Catherine Thomson
Environmental Management Team

THE OFFSHORE PETROLEUM PRODUCTION AND PIPE-LINES (ASSESSMENT OF ENVIRONMENTAL EFFECTS) REGULATIONS 1999 (AS AMENDED) - THE OFFSHORE EIA REGULATIONS[1]

NOTICE PURSUANT TO REGULATION 9(1)

BP Exploration Operating Company Limited

Vorlich Field Development

Whereas the Secretary of State has been informed of a letter of application in respect of the above-named project, which was supported by an environmental statement submitted to the Department on 14 March 2018.

1. The Secretary of State gives notice to BP Exploration Operating Company Limited that the Secretary of State considers that those authorities listed in paragraph 2 are likely to be interested in the project by reason of either their particular environmental responsibilities or their local or regional competence. Accordingly, as required under regulation 9(2) of the Offshore EIA Regulations, BP Exploration Operating Company Limited must:

(i) serve on each of those authorities a copy of this notice, a copy of the letter of application submitted to the Oil and Gas Authority and a copy of the above-mentioned environmental statement;

(ii) give notice to those authorities stating that representations may be made to the Secretary of State by a date specified in the notice, being a date at least 30 days after the date on which the notice and the above-mentioned documents are served on the authorities;

(iii) include in the notice that representations to the Secretary of State should be made by letter or e-mail to:

Environmental Management Team
Department for Business, Energy and Industrial Strategy
Offshore Petroleum Regulator for Environment & Decommissioning
AB1 Building
Crimon Place
Aberdeen, AB10 1BJ
E-mail: EMT@beis.gov.uk

(iv) give notice to the Secretary of State of the name of every authority served the above-mentioned documents and the date of such service.

2. The designated authorities referred to in paragraph 1 are:

(a) Joint Nature Conservation Committee, Inverdee House, Baxter Street, Aberdeen, AB11 9QA. E-mail OIA@jncc.gov.uk.

[1] The latest amendments to the Offshore EIA Regulations now incorporate modifications made by article 2 of the Energy Act 2008 (Consequential Modifications) (Offshore Environmental Protection) Order 2010.

(b) Marine Scotland Science, Scottish Government, Marine Laboratory, 375 Victoria Road, Aberdeen AB11 9DB. E-mail MS.PON15@gov.scot.

(c) Navigation Safety Branch, Maritime and Coastguard Agency, Bay 2/25, Spring Place, 105 Commercial Road, Southampton SO15 1EG. E-mail Navigationsafety@mcga.gov.uk.

(d) Safeguarding Team, DIO Offshore Safeguarding, Building 49, Defence Infrastructure Organisation, Kingston Road, Sutton Coldfield, B75 7RL.

(e) Navigation Manager, The Northern Lighthouse Board, 84 George Street, Edinburgh, EH2 3DA.

For and on behalf of the Secretary of State

Derek Saward

....

pp **Nienke Mayo**
Environmental Manager
Authorised to act in that behalf
Dated 4th April 2018

Annex

PUBLICATION NOTICE

Oil / Gas Field Development / Gas Storage Project

This Annex provides a template for the public notice advertisement to be placed in the newspapers as recommended in the Department's letter of acknowledgement of the Environmental Statement submitted in support of your letter of application to the Oil and Gas Authority.

Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)

Vorlich Field Development

The Secretary of State for Business, Energy and Industrial Strategy has been informed that BP Exploration Operating Company Limited has submitted a letter of application to the Oil and gas Authority in relation to the Vorlich Field development project located [Insert number of miles] from the [Insert relevant UK area coastline], at [Insert Latitude and Longitude coordinates using format 00° 00' 00.00" N; 00° 00' 00.00" E/W]. In accordance with the above-mentioned Regulations, this letter of application is supported by an Environmental Statement, copies of which may be inspected between 10 am and 4 pm on business days at [Insert full postal address] until close of business on [Insert date using format DD/MM/YYYY, which must be at least 30 days after the date of the last publication of the notice]. Copies of the Environmental Statement may also be obtained from [Insert full postal address or specify 'the address detailed above'] (subject to a discretionary charge of £2), or may be accessed via the internet at [Insert relevant website address].

Interested parties have until the date specified above to make representations in relation to the submission to the Secretary of State. All representations should quote the Department's reference number ([Insert BEIS reference number]) and may be made by letter or e-mail to:

Environmental Management Team
Department for Business, Energy and Industrial Strategy
Offshore Petroleum Regulator for Environment & Decommissioning
AB1 Building
Crimon Place
Aberdeen, AB10 1BJ
Email: EMT@beis.gov.uk

Copies of representations may be made publicly available. Following receipt of all representations the Secretary of State will either agree to the grant or refusal of the consent (with or without conditions). Notice of the Secretary of State's decision will then be published in the London, Edinburgh and Belfast Gazettes, and on the GOV.UK website.

Within six weeks from the date of publication of the Secretary of State's decision to agree to the grant of consent, an approval as referred to in regulation 11 or the imposition of a relevant requirement in respect of the project as referred to in regulation 11, any person aggrieved by the decision may apply to the Court. The Court may grant an order quashing the grant of consent, the approval or the imposition of the requirement where it is satisfied the action was done in contravention of the requirement to consider the Environmental Statement, any other relevant information or any representations received from relevant authorities or other interested parties. The court may also grant such an order where the interests of the aggrieved person have been prejudiced by a failure to comply with any other requirement of the Regulations. Pending determination of the application by an aggrieved person, the court may by interim order, stay the operation of the consent, the approval or the requirement.

Notes

The period of public notice must be a minimum 30 days from the date of the last advertisement - so where notices are required in more than one newspaper the end date must be 30 days after the later or latest advertisement, and all advertisements should show the same closing date.

The Regulations permit a maximum charge of £2 for a copy of the Environmental Statement, but the text relating to the charge can be removed if you do not intend to request a fee.