Barnacle Field

Environmental Statement

Licence P.2460 (UKCS)

Ref No D/4235/2019 - June 2019

Barnacle Field Environmental Statement

			Marten Meynell Digitally signed by Marten Meynell Date: 2019.06.06 10:11:49 +01'00'	Nichola Lacey Digitally signed by Nichola Lacey Date: 2019.06.06 10:18:00 +01'00'	Marten Meynell Digitally signed by Marten Meynell Date: 2019.06.06 10:12:13 +01'00'	
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Rev	**Date**	**Description**	**Issued By**	**Checked By**	**Approved By**	**Client Approval**

ENVIRONMENTAL STATEMENT DETAILS

Section A: Administrative Information

A1 – Project Reference Number

Number: D/4235/2019

A2 - Applicant Contact Details

Company name: Equinor UK Limited

Contact name: Susannah Betts

Contact title: Lead Environmental Engineer, SSU UKI ENV

A3 - ES Contact Details (if different from above)

Company name:

Contact name:

Contact title:

A4 - ES Preparation

Please confirm the key expert staff involved in the preparation of the ES:

Name	Company	Title	Relevant Qualifications/Experience
Susannah Betts	Equinor UK Limited	Lead Environmental Engineer, SSU UKI ENV	Over 25 years in oil and gas related environmental management on and offshore
Joseph Ferris	ECAP Consultancy Group	Senior Associate	30+ years' experience working as a marine ecologist / environmental scientist PhD Ecology MSc Environmental and Marine Science BSc Biology and Chemistry
Marten Meynell	Xodus Group	EIA Project Manager	IEMA Affiliate 11 years' experience as Environmental Consultant / Environmental Advisor MSc Marine Resource Development and Protection BA (Hons) Sociology with Spanish

A5 - Licence Details

a) Please confirm licence(s) covering proposed activity or activities.

Licence number(s): P2460

b) Please confirm licensees and current equity.

Licensee	Percentage Equity
Equinor UK Limited	44.33688%
Spirit Energy	34.29595%
Esso Exploration and Production UK Limited	21.36717%

Section B: Project Information

B1 - Nature of Project

a) Please specify the name of the project.

Name: Barnacle Field Development

b) Please specify the name of the ES (if different from the project name).

Name:

c) Please provide a brief description of the project.

The Barnacle Field is located in the northern North Sea in the United Kingdom continental shelf (UKCS) Blocks 211/29 and 211/30. The main reservoirs in the Barnacle discovery are the Nansen and Eiriksson formations of the Lower Jurassic Statfjord Group. The Barnacle discovery is located within a down-faulted block at the south-western end of the Statfjord Main Field. In 1992 Shell drilled exploration well 211/29-10Z. The well discovered oil in the Lower Jurassic Statfjord Group. In 2007, Aurora Petroleum drilled the 211/29-D73 well from the Delta platform on the Brent Field. Equinor and partners propose a single well to drain the Barnacle volumes from the Statfjord B platform located in the Norwegian sector of the North Sea continental shelf. The Barnacle discovery is proposed as a potential tie-in candidate to the Equinor Energy AS operated Statfjord B platform. Production lifetime for the Statfjord B platform is currently expected to be until 2026. Due to the Statfjord B lifetime, Barnacle development is time-critical.

Barnacle will be developed with a single extended reach well drilled from an existing donor well (B-29) on the Statfjord B platform, approximately 2.5 km northeast of the UK/ Norway median line. The water depth at Statfjord B is 149 metres. Barnacle drilling is due to commence in August 2019 and is predicted to take 90 days, with start-up of production in Q4 2019. The production from the Barnacle well will continue until cessation of production on Statfjord B (currently 2026). The well will be drilled from the platform using oil based muds and drill fluids. All drilling cuttings will be re-injected in a disposal well. Drilling fluids will be re-used or shipped to shore for disposal. No new infrastructure on the Statfjord B platform will be needed to support production. The total oil reserves are estimated to range from about 900 to 2,600 MSBL (million standard barrels), with initial oil production rate for the well expected to be in the range 2,000 to 5,400 m SBL per day. Oil, gas and produced water will be processed on the Statfjord B. Produced water will be discharged to sea and the processed oil will be stored on Statfjord B for export via tanker. Produced gas will be used for artificial lift to optimise production rate and recovery. There will be no seabed activity or new infrastructure installed in the UK sector as part of this development plan.

B2 - Project Location

a) Please indicate the offshore location(s) of the main project elements.

<u>UK Sector</u>

Quadrant number: 211

Block numbers: 29f and 30c

<u>Norwegian Sector</u>

Quadrant number: 33

Block number: 09

<u>Development wells top-hole location</u>

Latitude: 61° 12' 23.87'' N Longitude: 1° 49' 50.78'' E

Distance to nearest UK coastline: 144 km, Shetland

Distance to nearest international median line: 2.5 km to UK/ Norway median line

CONTENTS

NON-TECHNICAL SUMMARY

Introduction

This Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) conducted by Equinor UK Limited (Equinor (formerly known as Statoil)) on behalf of the licence group for the development of the Barnacle oil field in United Kingdom Continental Shelf (UKCS) Blocks 211/29f and 211/30c, south of the Statfjord Field and northeast of the Brent Field in the northern North Sea (NNS). Equinor and partners propose to drill a single well to access the Barnacle reserves in the UKCS and develop the field via the Statfjord B platform located in the Norwegian Continental Shelf (NCS).

Project description

Barnacle will be developed with an extended reach drilling (ERD) well from the Statfjord B platform, approximately 2.5 km to the northeast of the Barnacle Field. The Statfjord B platform is located in Block 33/9 in the Norwegian Sector. The basis of design for the Barnacle well is a tie-in to the Statfjord B platform. Statfjord B platform is a condeep (concrete deep-water structure) production platform. The condeep consists of a base of concrete oil storage tanks from which four concrete shafts rise. Stabilised oil is stored in the cells of these shafts before being discharged to shuttle tankers via loading buoys and shipped to ports in north-western Europe. Barnacle produced gas will be taken over by the Statfjord Unit and used as compensation for services, including for gas-lift and as fuel and flare.

The well will target the eastern part of the geological structure close to UK wells 211/29-D73 and 211/29-D73Z. The Barnacle well will be drilled as a four section well from an existing donor well (B-29) on the Statfjord B platform, with an exit point below the 20" casing shoe and completed in the reservoir section with 4" expandable hydraulic screens for sand protection. Due to the low reservoir pressure on Statfjord wells, continuous artificial lift is necessary to guarantee continuous and optimal production. The well will be completed with gas-lift to optimise production rate and recovery.

Barnacle drilling is due to commence in August 2019, with drilling expected to take 90 days. Start-up of production will be in the fourth quarter (Q4) of 2019 and will continue through till cessation of production (CoP) on Statfjord B, which is currently expected to be in 2026. The well will be drilled using oil based muds (OBM) which will be returned to the platform. All drilling cuttings will be re-injected in a disposal well. Drilling fluids will be re-used or shipped to shore for disposal. Statfjord B has an 83% recycling rate for oil based drilling fluids.

Reservoir fluids produced during final well clean-up will be routed to the test separator. Separated water will proceed to the recycled oil sump for manual sampling of oil in water (average oil in water concentration will not exceed 30 mg/l), followed by discharge to sea via the open drain's caisson.

The specific chemicals and additives used during drilling and cementing will be dependent upon the drilling mud and cement package, which will be designed specifically for the well. Use will also vary depending on the exact down-hole conditions experienced during drilling.

The Barnacle well will produce oil, gas and water in varying proportions over the field life. The three phases will be separated in the production train on the Statfjord B platform. The inclusion of the produced oil and gas from the Barnacle well will not increase the overall production from the Statfjord B platform. Production from currently operating wells has been decreasing and the inclusion of the Barnacle oil and gas will supplement the total production from the platform. The oil processed on Statfjord B is in decline and will continue to decline but at a slower rate with the inclusion of the Barnacle Field production. Production and processing of Barnacle oil and gas on the Statfjord B platform will not require installation of any additional equipment.

As the Barnacle Field will be drained from a single well from the Statfjord B platform within the Norwegian sector, there will be no subsea infrastructure in the UKCS. Therefore, there is no UKCS decommissioning requirement, and the well abandonment will form part of the Statfjord B platform abandonment and decommissioning plan

Environmental baseline

The environmental baseline conditions at the Barnacle Field and Statfjord B platform are summarised in the table below.

Physical environment
The Barnacle Field and Statfjord B platform is located in the open sea in water depth of approximately 140 to 149 m below lowest astronomical tide. Average tidal currents in this region range from 0.10 m/s (neap tides) to 0.20 metres/ second (spring tides), with the major directional axis being in a north-south direction. The annual mean wave height at the Statfjord Field varies between 2.3 and 2.5 m. In the vicinity of the Statfjord B, water temperature is relatively uniform throughout the water column during the winter months, with a mean temperature of 7.25°C at the seabed and 7.75°C at the sea surface. Over the spring and summer months a thermocline develops, which separates an upper, warmer, less dense surface layer. The mean surface temperature is 13.25°C. Seabed sediments in this region are predominantly deep circalittoral sand, with localised areas of deep circalittoral coarse sediment. The sediment in the vicinity of Statfjord B platform is dominated by sand (average 90.3%) and with a low organic content (average 1.5%).
Plankton
The phytoplankton community is dominated by dinoflagellates of the genus *Ceratium (C. fusus, C. furca and C. lineatum)* and diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. Two main phytoplankton blooms occur annually in May and August. Zooplankton is dominated by calanoid copepods, in particular *Calanus* spp. and *Acartia* spp. The historically abundant *C. finmarchicus* has declined dramatically over the last 60 years likely due to changes in seawater temperature and salinity. It has largely been replaced by boreal and temperate Atlantic and neritic (coastal water) species, in particular *C. helgolandicus.* The colder waters of the NNS also supports *Paracalanus* spp. and *Pseudocalanus* spp.
Benthos
Benthic communities in the Barnacle Field Development area are similar to those found throughout a large surrounding area of the NNS. There were large variations in the number of individuals per station, taxa, and diversity over the Statfjord Field. Benthic infauna are dominated by polychaetes, molluscs and crustaceans and an epifauna dominated by echinoderms and crustaceans. Data from benthic surveys in UKCS Block 211/29 indicate that characteristic infaunal species associated with this region of the North Sea include the polychaetes *Myriochele* spp. and *Owenia* fusiformis, and *Thyasira* spp. The epifauna of the project area can be characterised by the hermit crab *Pagurus bernharus*, the shrimp *Crangon allmani*, the purple heart urchin *Spatangus purpureus* and the mollusc *Colus gracilis.*
Fish
The Barnacle Field and Statfjord B platform are located in an area in which there are spawning grounds for cod (January to April), haddock (February to May), herring (August to January), Norway pout (January to April), saithe (January to April) and whiting (February to June), and nursery grounds for anglerfish, blue whiting, European hake, haddock, herring, ling, mackerel, sprat, plaice, Norway pout, and spur dog (throughout the year).
Seabirds
Much of the North Sea and its surrounding coastline and offshore waters are internationally important breeding and feeding habitats for seabirds. Seabirds are not normally affected by routine offshore oil and gas operations. In the unlikely event of an oil release, however, birds are vulnerable to oiling from surface pollution. Seabird sensitivity to oil pollution in the Barnacle Field and Statfjord B platform area is “low to medium” from January to October and “high” in November and December. The overall vulnerability in the Barnacle Field Development area is “low”.

Marine mammals
The main marine mammal species occurring in the Barnacle Field Development area are harbour porpoise, killer whale, minke whale, sperm whale, pilot whale, white beaked dolphin and white-sided dolphin. The majority of sightings have taken place during the spring and summer period. All species are listed as Scottish Priority Marine Features and harbour porpoise is listed under Annex II of the Habitats Directive. The Statfjord B platform is located approximately 150 km from the nearest landfall so it is unlikely that seals will be present.
Conservation
There are no protected sites or known sensitive habitats within 40 km of the Barnacle Field or Statfjord B platform. The closest protected and potentially sensitive marine areas are over 100 km from the proposed development both on the UK and the Norwegian side of the median line. The closest offshore conservation sites in the UK are the Pobie Bank Reef Special Area of Conservation (SAC), an Annex I habitat, located approximately 102 km southwest of the Barnacle well and the North-east Faroe-Shetland Channel Nature Conservation Marine Protected Area (NCMPA), located approximately 133 km to the west of the proposed development area. In the Norwegian sector the Bremanger-Ytre Sula, an area important to seabirds, is located approximately 146 km from the Barnacle Field.
Other sea users
The NNS has important fishing grounds and is fished by both UK and international fishing fleets. The effort, value and quantity for UK vessels in this region has continually decreased from 2013. In 2017 demersal fishing accounted for 98% of the UK catch landed, which was below the average for UK landings in the North Sea. Norwegian vessels are the largest commercial fishing effort in this region, particularly for saithe, mackerel and herring. The Barnacle Field and Statfjord B platform is located within an area of major oil and gas development and infrastructure in the UKCS and NCS. However, shipping density in the Barnacle Field Development area ranges from low to very low density.

Environmental impact methodology

The nature and scale of the potential environmental issues resulting from the Barnacle Field Development are well understood since drilling of development wells from the Statfjord B platform and subsequent production of oil and gas via the platform have previously been subject to review and approval by the Norwegian regulators.

The known issues were therefore reviewed in order to identify any potential for significant environmental issues; the issues considered were:

- Discharges to sea;
- Seabed disturbance;
- Underwater noise;
- Interaction with other sea users;
- Waste generation;
- Atmospheric emissions; and
- Accidental events.

The potential for cumulative impacts in combination with third-party projects was assessed, as was the potential for transboundary impacts.

Environmental impact significance was assessed with reference to the following guidance:

- Institute of Ecology and Environmental Management (IEEM) guidelines for marine impact assessment;

- Marine Life Information Network (MarLIN) species and ecosystem sensitivities guidelines;
- Scottish Natural Heritage (SNH) handbook on EIA;
- Institute of Environmental Management and Assessment Guidelines for EIA; and
- Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) EIA Guidance 'The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide' (rev 5, February 2019).

Impact assessment

Since no new infrastructure will be required in the UK sector of the UKCS for completion of the development and the drilling of the well will take place from an existing platform in the NCS the following potential environmental issues were considered likely to be insignificant and scoped-out of further impact assessment:

- Seabed disturbance;
- Underwater noise;
- Waste generation; and
- Interaction with other sea users.

The remaining environmental issues relative to their potential short- and long-term environmental impacts, scale of impacts, cumulative and transboundary impacts, and residual impacts were assessed in the EIA.

Discharges to sea

Drilling and operation of the Barnacle well will result in discharges to sea including cement during the drilling phase, and discharges of produced water and production chemicals during the operational phase. Discharges of cement are expected to be restricted to the area immediately around the wellhead at the platform in an area that has already been developed and therefore expected to be not significant. All drilling cuttings will be re-injected in a disposal well. Drilling fluids will be re-used or shipped to shore for disposal. Statfjord B has an 83% recycling rate for oil based drilling fluids.

During the operational phase the principal disposal route for formation water produced from the Barnacle well and processed on the Statfjord B platform will be discharged to sea. Before disposal, water will be treated to the Norwegian regulatory oil-in-water standard of less than 30 mg/l. Chemicals injected into the wells or into the process fluids stream may partition into the water phase and therefore be discharged overboard.

Water column cumulative impacts from produced water discharges are expected to be negligible and any small increase due to the proposed Barnacle development is not expected to change the expected impact magnitude. The nearest third-party infrastructure in the UKCS to the proposed drilling location is the Brent Field located approximately 10 km southwest from Statfjord B platform. Due to the low volume and distance to the nearest operating facility, there is no possibility of the Statfjord B discharges interacting with this or any other third-party development. As such, significant cumulative impacts are not expected.

The UK/ Norway median line is 2.5 km away. However, for reasons discussed above any transboundary impacts are not expected to be significant.

Atmospheric emissions

Local, regional and transboundary issues include the potential generation of acid rain from nitrogen and sulphur oxides (NO_X and SO_X) released from combustion, and the human health impacts of ground level nitrogen dioxide (NO_2), sulphur dioxide (SO_2), both of which will be released from combustion, and ozone (O_3), generated via the action of sunlight on NOx and volatile organic compounds (VOCs). On a global scale, concern with regard to atmospheric emissions is increasingly focused on global climate change.

Emissions from the Statfjord B platform are expected to decrease from 2019 through to CoP in 2026, even with the inclusion of the Barnacle well. The principal emissions from development of the Barnacle well will result from use of diesel, fuel gas and flaring. Flaring is expected to be less than 10%, and will only be a result of process problems or for safety reasons. There will be no cold venting associated with the Barnacle production and storage.

The total annual CO_2 emissions estimate from oil and gas exploration and production for 2016 is 13,100,000 tonnes. The total CO_2 emissions from the Statfjord B platform for 2018 was reported as 296,720 tonnes. For the Norwegian oil and gas industry the reported total CO_2 emissions for 2017 was 14,700,00 tonnes. Statfjord B accounts for approximately 2% of the overall annual offshore emissions for the UK and Norway from the oil and gas industry. The average CO_2 emissions from the Statfjord B platform are not expected to change during the production from the Barnacle Field.

While the Barnacle Field Development is in close proximity to other offshore oil and gas activities (including other offshore oil and gas activity), the low levels of emissions expected, and the dispersive offshore climate prevailing within the area, suggest there will not be any likely cumulative effects in terms of local air quality. While atmospheric emissions from the Barnacle Field Development will cross into the UK this is not expected to result in significant transboundary impacts.

Accidental events

The worst-case accidental event is considered to be a well blowout, which modelling predicts could result in significant impacts to coastal protected sites on the Norwegian coast, as well as crossing the UK/ Norway median line and potentially impacting the east of Shetland in low volumes. The likelihood of such an event occurring is however remote, and as such the consequence is expected to be low with residual impact therefore considered not significant.

Given the low likelihood of a well blowout or other major environmental incident occurring, and the low quantities of oil predicted to reach the waters and shoreline around Shetland, impacts on protected sites and features were not quantified. The risk of an accidental hydrocarbon release having a transboundary impact is recognised by the UK and Norwegian governments. Agreements are in existence for dealing with international releases with states bordering the UK (e.g., Bonn Agreement). In the event of a major accidental release, the Norwegian/ British oil spill response (NORBRIT) plan will be activated.

Environmental management

Equinor operates an Environmental Management System (EMS) in accordance with the requirements of ISO14001. The Equinor EMS has been independently verified by Lloyd's Register Consulting Ltd. and was declared compliant with the OSPAR and associated regulatory requirements on 18th January 2018.

The operations described within this ES fall within the scope of the EMS. It is the aim of Equinor to ensure best environmental practices and procedures are followed and that continual improvement in environmental performance is maintained at all times.

Emergency Response Bridging Documents are prepared for all offshore activities involving contractor facilities and vessels. Management system interfacing and procedural precedence is defined in contract documents, and for high-risk activities is further clarified by preparation of Management System Interface documents. These documents clearly define the interfaces and establish the agreed arrangements including responsibilities, systems, procedures and practices, for managing health, safety and environment during contracted works.

Equinor considers that the Project is in broad alignment with the objectives and policies set out in the Scottish National Marine Plan across the following policy topics: natural heritage, air quality, cumulative impacts, and oil and gas.

Equinor will be required to apply for drilling and production permits as advised by OPRED. This will be limited to a UK drilling permit for the sections of the well underlying the UKCS and a production permit for start of production. There will be no chemical permit as there is no use or discharge of chemicals in UK waters.

Conclusions

The risks and impacts associated with the proposed Barnacle Field Development, the drilling of the well into the Barnacle Field and production of the wells via the Statfjord B platform will result in very little net change in impacts and risks.

While a major accidental event has the potential to significantly affect protected sites and to cross the UK/ Norway median line, the likelihood of such an event occurring is remote and the volumes of oil that may reach the Shetland coastline in such an event is predicted to be low; as such the residual impact on these receptors is considered not significant.

It is therefore concluded that there are no significant environmental impacts associated with the proposed Barnacle Field Development. In considering the requirements of Scotland's National Marine Plan, this conclusion confirms that the Project will be consistent with the objectives and policies set out, together with the sectoral policies outlined for the oil and gas sector.

The proposed development is not expected to have likely significant effects on any EU protected sites or species. Similarly, there is considered to be no scope for significant risk to the conservation objectives of any National Conservation Marine Protected Areas.

The findings and recommendations of this EIA will be carried through by formal commitments which will provide a transparent and auditable means of ensuring the measures identified will be delivered through Equinor's EMS. It is the conclusion of this ES that the current proposal to develop the Barnacle Field can be completed without causing significant impact to the environment or society.

1 INTRODUCTION

This Environmental Statement (ES) presents the findings of the Environmental Impact Assessment (EIA) conducted by Equinor (UK) Limited (Equinor) for the development of the Barnacle Field. The Barnacle Field Development project falls into the mandatory EIA category because production from the field is expected to peak at more than 500 tonnes of oil per day. The purpose of the EIA was to assess the potential for significant environmental impacts due to the proposed field development, and ensure that where significant impacts are identified, these are reduced using appropriate mitigation measures to a level that is not environmentally significant.

1.1 The Barnacle Field

The Barnacle Field is located in the northern North Sea (NNS) in the United Kingdom Continental Shelf (UKCS) Blocks 211/29f and 211/30c on the UK and Norwegian boundary. The main reservoirs are the Nansen and Eriksson formations of the Lower Jurassic Statfjord Group south of the Statfjord Main Field and northeast of the Brent Field (Figure 1.1). Barnacle was historically licensed under P257 issued in 1977 to Shell UK Limited and partners Esso Exploration and Production UK. Part of the licence, the Barnacle Field area, was later acquired by Aurora Petroleum, and relinquished in 2016. Equinor and partners were awarded P2460 which encompasses the Barnacle Field on 1st October 2018 as part of the UK 30th Licensing Round.

The license equities reflect an owner position equal to that of the Statfjord Field Development in the Norwegian Sector in order to facilitate ease of access and tie-in arrangement, with the licence interests being:

- Equinor UK Limited: 44.33688 %
- Spirit Energy: 34.29595 %
- Esso Exploration and Production UK Limited: 21.36717 %.

1.2 Proposed development

Barnacle will be developed with an extended reach drilling (ERD) well, drilled as a sidetrack from an existing donor well (B-29) on the Statfjord B platform, approximately 2.5 km to the northeast. The Statfjord B platform is located in Block 33/9 in the Norwegian Sector. The basis of design for the Barnacle well is a tie-in to the Statfjord B platform. The commercial arrangements will be executed through the tie-in processing agreement. There will be no subsea infrastructure placed on the UKCS seabed, nor will there be the need for any new processing equipment added to the Statfjord B platform.

1.3 Scope of environmental impact assessment

The EIA that is reported in this ES assesses the potential environmental and socio-economic impacts that could result from development of the Barnacle Field. The EIA process is integral to the project and involves identifying the possible impacts arising from project activities and developing control measures necessary to eliminate or minimise such impacts as far as reasonably practical. The process also provides for stakeholder involvement so that issues can be identified and addressed at an early stage, and also ensures that planned activities comply with environmental legislative requirements and with Equinor's environmental policy.

The EIA considers the risks from both routine activities and accidental events with their possible environmental implications.

Key elements of this ES include:

- A non-technical summary of the ES;
- Description of the proposed project; role of the EIA and legislative context (this chapter);
- Description of the project and alternatives considered (Chapter 2);
- Description of the environment and identification of the key environmental sensitivities which may be impacted by the project (Chapter 3);

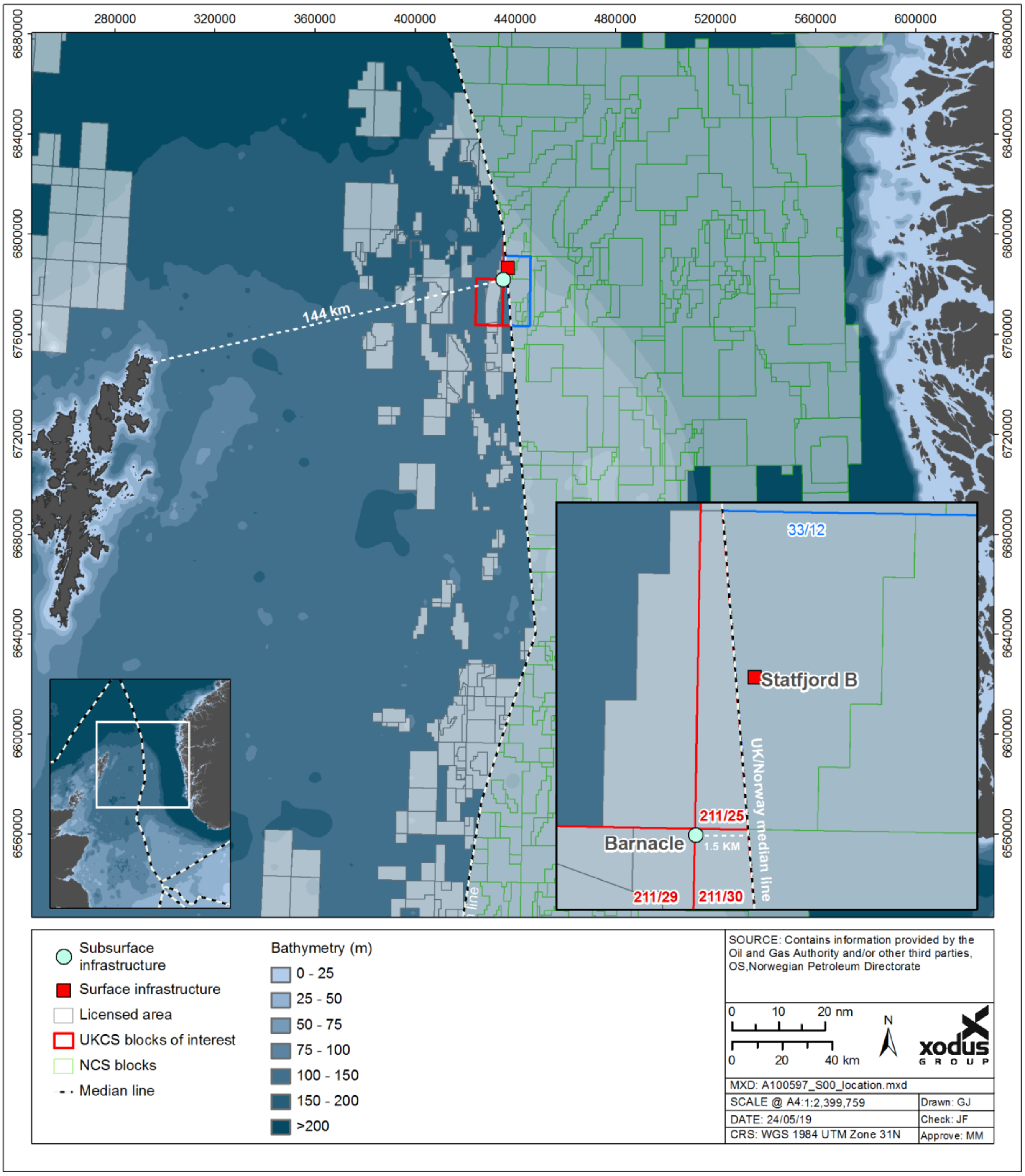

Figure 1.1 Location of the Barnacle licence area and Statfjord B Platform

- Description of the methods used to identify and evaluate the potential environmental impacts and scope of the EIA (Chapter 4);
- Detailed assessment of key potential impacts, including assessment of potential cumulative and transboundary impacts (Chapter 5);
- Description of the environmental management that will be in place during the project (Chapter 6); and
- Conclusions (Chapter 7).

The ES is submitted for review to the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), part of the Department for Business, Energy and Industrial Strategy (BEIS), to inform the decision on whether the project may proceed. The ES is also subject to formal public consultation as part of the review process.

1.4 Legislation and policy

The EIA has been carried out in accordance with the requirements of the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999, as amended, and the associated guidance on the interpretation of the regulations (BEIS, 2018). These Regulations require the undertaking of an EIA and the production of an ES for certain types of offshore oil and gas developments with a potential to have a significant impact on the environment.

An EIA is mandatory for any UK offshore oil and gas development that is expected to produce more than 500 tonnes of oil per day or more than 500,000 cubic metres (m^3) gas per day. The Barnacle Field Development is predicted to result in a peak oil production rate exceeding 500 tonnes per day, and must therefore be supported by an EIA.

As well as the requirement to carry out an EIA, other key regulatory drivers applicable to the project include:

- The Petroleum Act 1998;
- The Petroleum Licensing (Production) (Seaward Areas) Regulations 2008;
- Energy Act 2008, as amended;
- Marine and Coastal Access Act 2009;
- The Conservation of Offshore Marine Habitats and Species Regulations 2017;
- Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001, as amended;
- The Offshore Chemical Regulations 2002, as amended;
- Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005, as amended;
- Pollution Prevention and Control (Scotland) Amendment Regulations 2017;
- The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998;
- The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008 (as amended);
- The Offshore Installations (Emergency Pollution Control) Regulations 2002;
- Merchant Shipping (Prevention of Oil Pollution) Regulations 1996, as amended;
- Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008;
- International Convention for the Control and Management of Ships' Ballast Water and Sediments; and,
- Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015.

The oil and gas industry in Norway is regulated primarily by the Petroleum Act (Act 29 November 1996, No 72, as amended). All petroleum activities are subject to prior authorisation by the relevant regulatory authorities. These regulations fall under the authority of the Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate and consist of statutes, overarching guidelines and regulations stipulated by the Norwegian Petroleum Directorate.

Pursuant to the Petroleum Act, petroleum activities must take place within a sound health, safety and working environment framework. Environmental concerns must be taken into account and are regulated primarily by the Pollution Control Act which is administered by the Norwegian Environment Agency. Drilling and well operations are regulated by NORSOK standard D-010 Drilling and well operations, revision 4: Well integrity in drilling and well operations.

1.5 Scotland's National Marine Plan

The National Marine Plan (Scottish Government, 2015) provides an overarching framework for marine activity in Scottish waters out to 200 nautical miles (NM), with the aim of enabling sustainable development and the use of the marine area in a way that protects and enhances the marine environment, whilst promoting both existing and emerging industries. This is underpinned by a core set of general policies which apply across existing and future development and use of the marine environment. Policies of particular relevance to the Barnacle project include:

- General planning principle: There is a presumption in favour of sustainable development and use of the marine environment when consistent with the policies and objectives of the Plan.
- 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.
- Natural heritage: Development and use of the marine environment must:
  - Comply with legal requirements for protected areas and protected species;
  - Not result in significant impact on the national status of Priority Marine Features (PMFs);
  - Protect, and where appropriate enhance the health of the marine area.
- 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.
- Air quality: Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.
- Engagement: Early and effective engagement should be undertaken with the general public and interested stakeholders to facilitate planning and consenting processes
- Cumulative impacts: Cumulative impacts affecting the ecosystem of the Plan area should be addressed in decision-making and Plan implementation.

Sectoral policies are also outlined in the Plan where a particular industry may have issues beyond those set out in the general policies. Policies and objectives relating to the oil and gas sector are discussed in Section 6 below, along with comment on the degree to which the Barnacle project is aligned with these. Blocks 211/29 and 211/30, in which the Barnacle well will be drilled, are located approximately 144 km northeast of the Shetland coastline within the area covered by the Scottish National Marine Plan.

1.6 Environmental management

Equinor and its contractors operate their facilities according to the Equinor Group's management system (as modified to reflect local conditions and regulations) and best industry practices. Equinor operates an environmental management system (EMS) in accordance with the requirements of ISO14001. The Equinor EMS is subject to biennial, independent verification for alignment with the requirements of ISO14001. The most recent verification against ISO14001:2015 was conducted by Lloyds Register Consulting Ltd. in Q1 of 2018 and the EMS was declared compliant with OSPAR and OPRED requirements on 18th January 2018.

The EMS aligns with Equinor's Health, Safety and Environmental (HSE) policy, which is designed to ensure safe and secure operations and respect to the environment (Figure 1.2).

The operations described within this ES fall within the scope of the EMS. Equinor aims to ensure best environmental practices and procedures are followed during the proposed operations and that continual improvement in environmental performance is maintained at all times. Further detail on Equinor's environmental management procedures is provided in Section 6 below.

1.7 Stakeholder consultation

Due to the very limited scope of the proposed development, consultation has been limited to several informal meetings with OPRED, and communication has been maintained with OPRED throughout the EIA process. Information on the consultation undertaken for the Barnacle project is provided in Chapter 4.

1.8 Data gaps and uncertainties

Since there will be no new infrastructure on the water or seabed in the UKCS, the environmental baseline and impact assessment focuses on an area surrounding the existing Statfjord B platform in the NCS and the associated physical and biological environment. Any gaps in the understanding of the receiving environment have been highlighted in the Environment Baseline in Chapter 3.

1.9 Contact address

Any questions, comments or requests for additional information regarding this ES should be addressed to:

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Equinor UK HSE Policy

We aim to always conduct safe, secure operations and respect the environment

We are committed to providing a safe and secure environment for everyone working at our facilities and job sites. Equinor's safety and security vision is zero harm. We provide an environment recognised for its equality and diversity, and we treat everyone with fairness, respect and dignity. We do not tolerate any discrimination or harassment of colleagues or others affected by our operations.

OUR FOCUS AREAS:

- Safety, security and compliance with code of conduct is our priority
- Values, code of conduct and governance framework are integrated into all our activities
- Commitment to continuously improve safety and security culture
- Transparent approach to ethics and compliance

SAFETY IS INTEGRATED IN EVERYTHING WE DO

Every employee and contractor is accountable for safety and security, and it is up to us to demonstrate this commitment every day through our actions. We shall:

- Understand and manage risks
- Look after our colleagues
- Stop unsafe behaviour and activities
- Openly report and learn from all incidents
- Systematically use Compliance and Leadership
- Be visible and engaged in our team's safety and security
- Continuously improve safety and security
- Actively search for weak signals and act

Always Safe
High Value
Low Carbon

Figure 1.2 Equinor's Health, Safety and Environmental Policy

2 PROJECT DESCRIPTION

This chapter provides an overview of the proposed Barnacle Field Development and describes the proposed production well and process train of the project design. The objective of the field development is to exploit the hydrocarbon reserves of the Barnacle Field.

2.1 Project overview and consideration of alternatives

The proposed project will be undertaken from the existing Statfjord B platform in the NCS. The Statfjord Field (Statfjord Unit) was developed with three fully integrated concrete facilities: Statfjord A, Statfjord B and Statfjord C. Statfjord A, centrally located on the field, came on stream in 1979. Statfjord B, in the southern part of the field, in 1982, and Statfjord C, in the northern part, in 1985. The proposed well will be drilled as a sidetrack from an existing donor well (B-29) on the Statfjord B platform, as an ERD well to Barnacle, located southwest of the Statfjord Field on the UK side. Statfjord B platform is a condeep (concrete deep-water structure) production platform. The condeep consists of a base of concrete oil storage tanks from which four concrete shafts rise. The shafts rise to about 30 m above sea level. Stabilised oil is stored in the cells before being discharged to shuttle tankers via loading buoys and shipped to a number of ports in north-western Europe. The gas from the field is piped to the Far North Liquids and Gas System (FLAGS).

The well will target the eastern part of the structure close to wells 211/29-D73 and 211/29-D73Z, so as to produce oil from the Upper Statfjord reservoir (Nansen and Eriksson Formations). The Barnacle well will be drilled from the donor well as a four section well with an exit point below the 20" casing shoe and completed in the reservoir section with 4" expandable hydraulic screens (EHS) for sand protection. Due to the low reservoir pressure on Statfjord wells, continuous artificial lift is necessary for liquid producers to guarantee continuous and optimal production. The well will be completed with gas-lift to optimise production rate and recovery. No alternative drilling approach or fall-back target was evaluated. Should a sidetrack into the reservoir become necessary for technical reasons, the sidetrack target will be as close as possible to the original target.

Barnacle allocated oil will be based on well allocation using performance curves which are regularly verified by well testing in accordance with Statfjord operating procedures. Metering will be done by using the existing meters on the test separator. Barnacle gas will be allocated to Statfjord Unit. Fiscal metering of Barnacle oil when offloading to tanker will be based on the above described final daily well allocation. Basis for the Barnacle well, is a tie-in to the Statfjord B platform. The commercial arrangements will be executed through the tie-in processing agreement.

2.2 Project schedule

Barnacle drilling is due to commence in August 2019, with drilling expected to take 90 days. Start-up of production will be in the fourth quarter (Q4) of 2019 giving a total duration of about 12 to 14 months from licence award to start-up. The production of the well will continue until the end of 2025, with cessation of production (CoP) on Statfjord B (currently expected to be in 2026). The proposed schedule is outlined in Table 2.1.

Table 2.1 Barnacle project schedule.

Project Activity	Aug 2019	Sep 2019	Oct 2019	Nov 2019	Dec 2019	2020	2021	2022	2023	2024	2025	2026
Plug and abandon of existing donor well (B-29), drilling and completion of Barnacle well												
Production												
CoP												◆

2.3 Drilling

The existing B-29 well on Statfjord B will be plugged and abandoned, and the Barnacle well will then be drilled as a sidetrack from this well at 629 m measured depth (MD). The well is planned with a total of six sections, of which the two top sections are part of the existing donor well and the four bottom sections will form part of the new Barnacle wellbore. The well will be drilled using oil based muds (OBM) which will be returned to the platform. All drilling cuttings will be re-injected in a disposal well. Drilling fluids will be re-used or shipped to shore for disposal. Statfjord B has an 83% recycling rate for oil based drilling fluids.

A summary of the planned drilling (Equinor, 2019a):

- 16" section will be kicked off below a 20" shoe at 629 m MD with an open hole cement kick-off plug. Planned section length is ~1,300 m with section total depth (TD) located in the Sele Formation. A 13⅜" x 13⅝" casing will be run and cemented.
- 12¼" section is ~4,500 m long with 80-degree sail angle. Section TD will be in the Shetland Formation with an angle of 59 degrees. A 9⅝" liner will be run and cemented.
- 8½" section is ~200 m long. Section will start at 59 degrees, and then drop to 38 degrees. A 7" liner will be run and cemented. Then 9⅝" tieback casing will be installed. The drilling window in the 8½" section is tight, hence 9⅝" tieback will be installed after drilling 8½" section to reduce ECD (equivalent circulating density).
- 6" section is ~ 100 m long tangent with an angle of 38 degrees.

The Barnacle area is slightly down-faulted from the Statfjord Main Field and the area is divided into a western and an eastern rotated fault-bounded closure. The well is planned to target the eastern fault-bounded closure where well 211/29-D73 is located. The well path is depicted in Figure 2.1 and the target location is presented in Table 2.2.

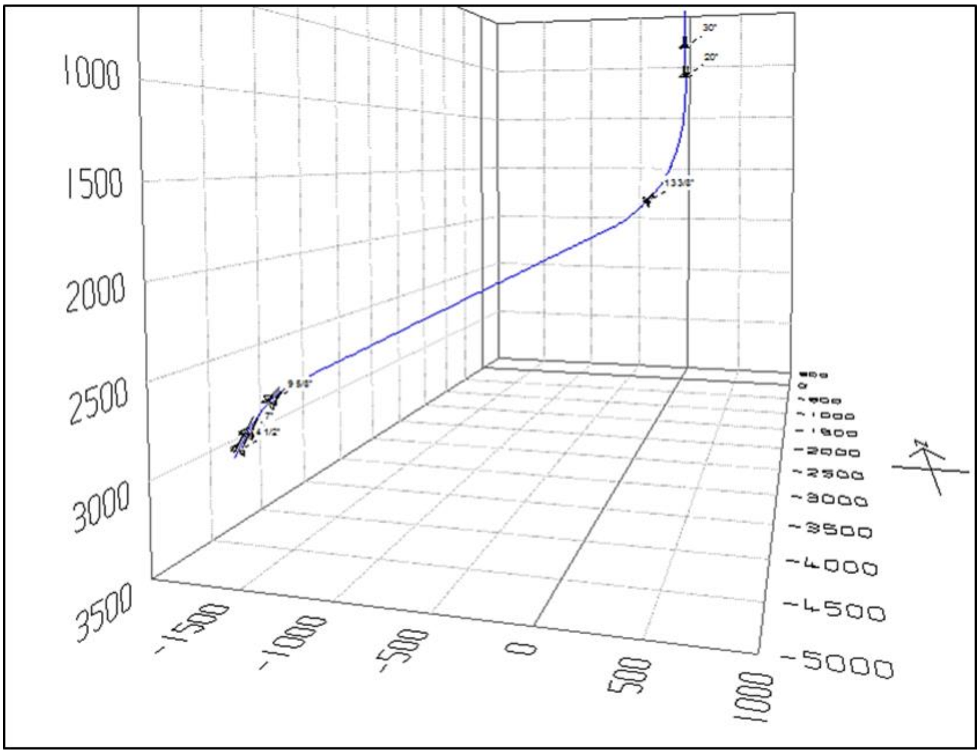

Figure 2.1 Barnacle well path – 3D view (Note: units are in metres)

Table 2.2 Target location for Barnacle Well

Northing (m)	Easting (m)	Latitude	Longitude	True Vertical Depth (TVD)
6781910.36	435472.40	61° 9' 58.932"	1° 48' 2.218"	2,794 m
Projection: WGS 1984 UTM Zone 31N				

2.4 Fluid properties

Oil fluid properties from the Barnacle well are expected to be the same as the rest of the Statfjord Group reservoir to the North, a light, low sulphur crude, with an American Petroleum Institute (API) gravity of 39.4. (Equinor, 2019a).

2.5 Well design

The well will be completed as a standard Statfjord Late Life (SFLL) completion design without the need for any wireline operations to start production. For protection against sand production, the chosen lower completion is 4" EHS inside a 6" open hole. The base pipe and blank pipes in the lower completion will be made of 13-Chromium-80 material. The proposed completed well design is shown in Figure 2.2. Though Figure 2.2 shows six sections, the top two sections are part of the current donor well and four new bottom sections will be drilled for Barnacle.

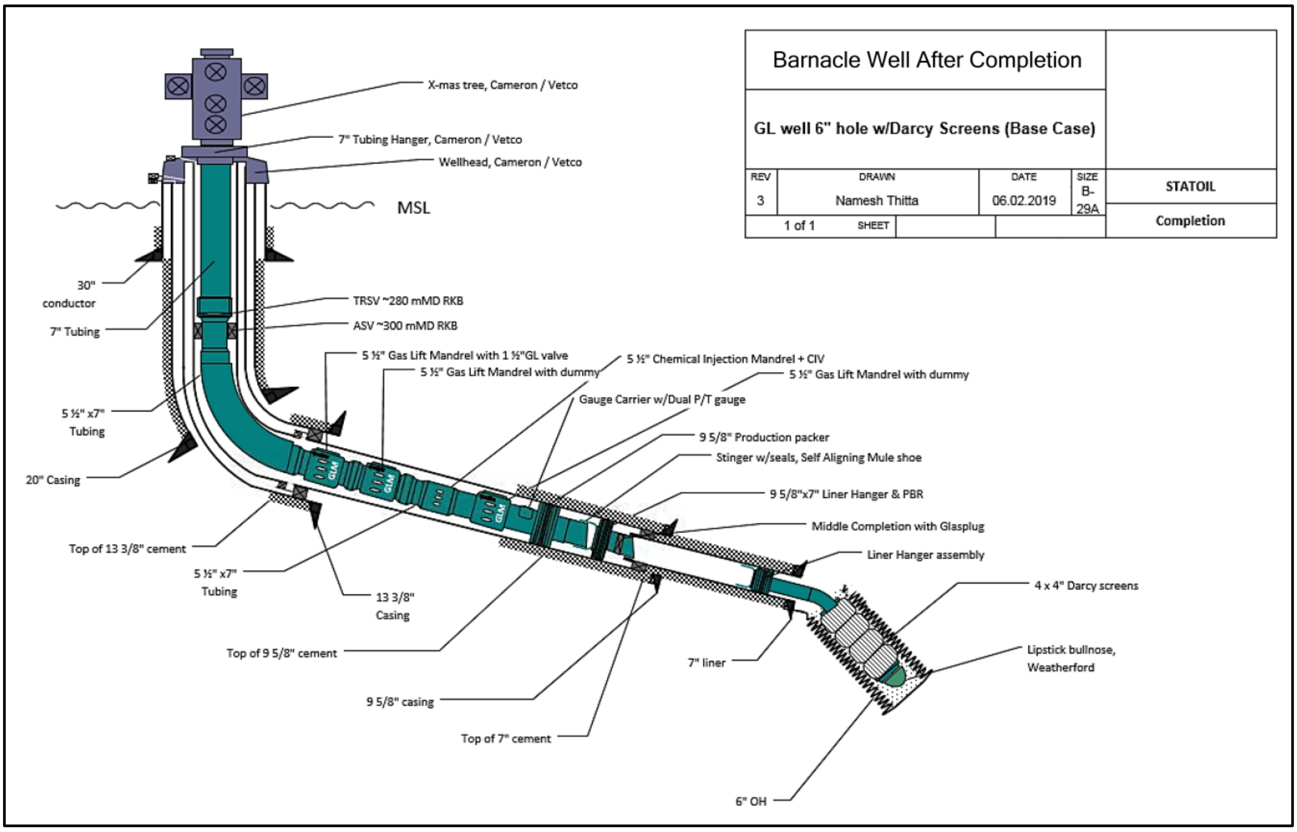

Figure 2.2 Barnacle well completed well design

2.6 Cementing

The steel casings run into each of the well sections will be cemented in place by circulating cement through the annulus (gap) between the outside of the casing and the surrounding rock formations. During cementing operations, it is normal practice to use a certain amount of excess cement to ensure the integrity of the cement job.

2.7 Well control

Well control and blowout contingencies have been evaluated in the concept design and a final well control plan will be in-place prior to the start of drilling (Equinor, 2019a). The well will utilise a blowout preventor, along with a detailed contingency plan and plans for relief wells.

2.8 Chemical use

The specific chemicals and additives used during drilling and cementing will be dependent upon the drilling mud and cement package, which have been designed specifically for the well. Use will also vary depending on the exact down-hole conditions experienced during drilling. There will be contingency chemicals available to deal with any predictable contingencies including stuck drill pipe and lost circulation (where drilling mud is lost into a porous formation). All chemicals will be selected on their technical specifications as well as for their potential environmental impacts.

Under Norwegian legislation, chemicals used in the petroleum industry on the Norwegian continental shelf are categorised as follows based on ecological toxicity:

- Black: Chemicals that normally are not allowed into the environment.
- Red: Chemicals presenting a potential environmental risk, which therefore should be replaced if possible.
- Yellow: All chemicals that are not covered by the other categories.
- Green: Pose Little or No Risk to the Environment (PLONOR), chemicals on the OSPAR's (Oslo-Paris Convention) PLONOR list.

No chemicals categorised as black or red will be used in connection with the development of the Barnacle well. In addition, selection of specific chemicals will be based on best available techniques (BAT) principle.

2.9 Well clean-up

Prior to running the EHS screens, the drilling mud will be displaced with low solid oil based mud (LSOBM). After setting the middle completion, the majority of LSOBM will be displaced with packer fluid (1.03 sg NaCl). Only a small volume of LSOBM will be left in the well below the middle completion. The displaced mud and LSOBM will be injected into the cutting re-injection (CRI) well B-9, into the Brent reservoir.

Start-up of the well using gas-lift is planned against the test separator, using the sand trap as the monitoring device to establish sand free production. If separation is good, the clean and clear water will be routed to sea. If water is not clean it will be routed together with the oil towards the stock tanks where gravity will help settle out particles over time. This water will then be displaced into the ballast water tank. When the water is clean and the flow is sand free it will be routed towards the low pressure (LP) processing train, and ultimately discharged.

During production, scale inhibitor will be added via a hydraulic line into the well flow to protect the side pocket mandrel[1] for gas-lift in the tubing. The plan is to produce against the LP train; the flowline towards the LP train will be made of duplex stainless steel and so there will be no need to add inhibitor to protect the flowline against corrosion. All discharges will be below regulatory limits. Acoustic detectors are clamped on the flowline to continuously monitor sand production in the flowline.

[1] A completion component that is used to house gas-lift valves and similar devices that require communication with the annulus. The design of a side-pocket mandrel is such that the installed components do not obstruct the production flow path, enabling access to the wellbore and completion components below.

2.10 Production

The Barnacle well will produce oil, gas and water in varying proportions over the field life. The three phases will be separated in the production train on Statfjord B. Stabilised oil is stored in storage cells and off-loaded onto tankers from one of the two oil-loading systems in the Statfjord field. Since 2007, gas is exported through Tampen Link, and routed via the FLAGS pipeline to the UK. Barnacle produced gas will be taken over by the Statfjord Unit and used as compensation for services, including gas-lift and as fuel and flare (Equinor, 2019a)

The well, when completed and ready for production, will be lined up to the Statfjord B inlet separator together with other Statfjord Unit wells on Statfjord B. As there will be no separate fiscal metering of the Barnacle well, ownership allocation will be based on well allocation using well performance data from testing in accordance with the Statfjord Unit operator's procedures.

Expected final recovery factor for the Barnacle well is 35%, ranging from 20 to 50%, giving cumulative oil reserves of about 270 kSm³ (thousand standard cubic metres), based on a reserve estimate of around 770 kSm³. Table 2.3 provides the estimated reserves for the mean production case.

Table 2.3 Mean production estimates for the Barnacle well.

	Cumulative Field Units		Cumulative Metric	
	Oil	Gas	Oil	Gas
Year	MMBO	BCF	mill Sm^3	mill Sm^3
2019	0.22	0.20	0.034	5.60
2020	1.06	0.94	0.146	26.70
2021	1.42	1.26	0.197	35.70
2022	1.58	1.40	0.215	39.50
2023	1.64	1.46	0.223	41.20
2024	1.67	1.48	0.230	41.90
2025	1.68	1.49	0.232	42.20

2.10.1 Oil production profiles

Barnacle will commence production in Q4 2019, with a projected lifetime until 2026. The predicted daily production for oil, gas and water is presented in Table 2.4. The oil production P10 forecast is presented in Figure 2.3. Figure 2.4 illustrates the P10 forecast for gas and Figure 2.5 produced water P10. The inclusion of the produced oil and gas from the Barnacle well will not increase the overall production from the Statfjord B platform. Production from currently operating wells has been decreasing and the inclusion of the Barnacle oil and gas will supplement the total production from the platform. The oil processed on Statfjord B is in decline and will continue to decline but at a slower rate with the inclusion of the Barnacle Field production (Figure 2.6).

Table 2.4 Predicted daily production rates for the Barnacle well

Month / Year	Production rates Oil tonnes/d P90	Mean	P10	Water tonnes/d P90	Mean	P10	Gas Sm^3/d P90	Mean	P10
Nov 2019	251	481	695	998	1,272	1,352	49067	94892	135851
Dec 2019	234	448	650	1,010	1,298	1,392	45731	88440	127157
Jan 2020	218	418	609	1,020	1,322	1,429	42621	82426	119019
Feb 2020	203	390	570	1,014	1,323	1,438	39723	76821	111401
Mar 2020	189	363	533	1,024	1,345	1,472	37022	71597	104272
Apr 2020	177	338	499	1,032	1,365	1,502	34504	66728	97598
May 2020	164	315	467	1,038	1,382	1,529	32158	62191	91352
Jun 2020	153	294	437	1,045	1,398	1,555	29971	57962	85506
Jul 2020	143	274	409	1,050	1,412	1,578	27933	54021	80033
Aug 2020	133	255	383	1,055	1,425	1,599	26034	50347	74911
Sep 2020	124	238	359	1,059	1,436	1,618	24263	46924	70117
Oct 2020	116	222	336	1,062	1,446	1,636	22613	43733	65629
Nov 2020	108	207	314	1,065	1,455	1,652	21076	40759	61429
Dec 2020	100	193	294	1,068	1,463	1,666	19643	37987	57498
2021	65	125	196	1,066	1,483	1,715	12774	24705	38321
2022	28	54	89	1,070	1,512	1,780	5487	10611	17328
2023	12	23	40	1,058	1,504	1,788	2357	4558	7835
2024	5	10	18	1,032	1,471	1,757	1013	1960	3546
2025	2	4	8	1,010	1,442	1,726	435	841	1602

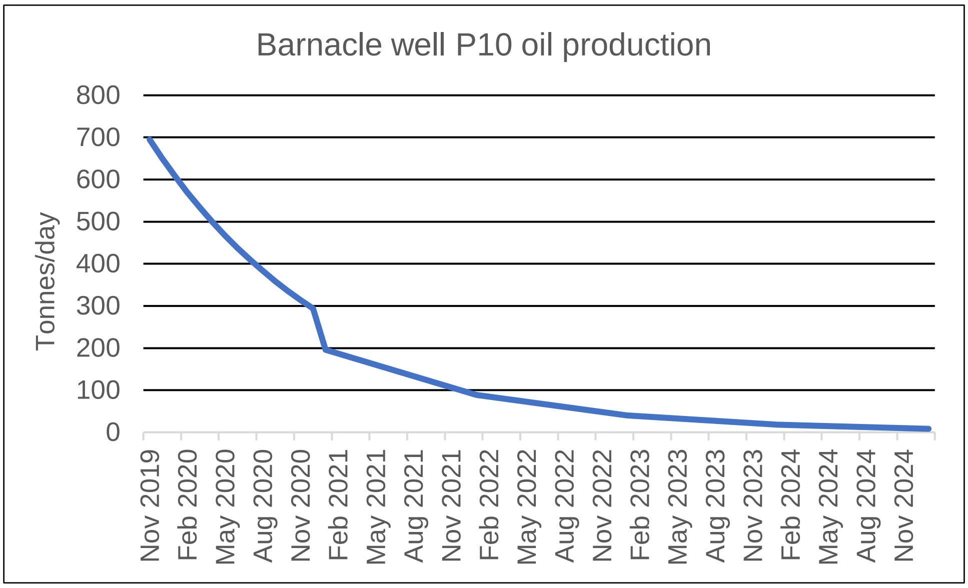

Figure 2.3 Barnacle well P10 oil production forecast.

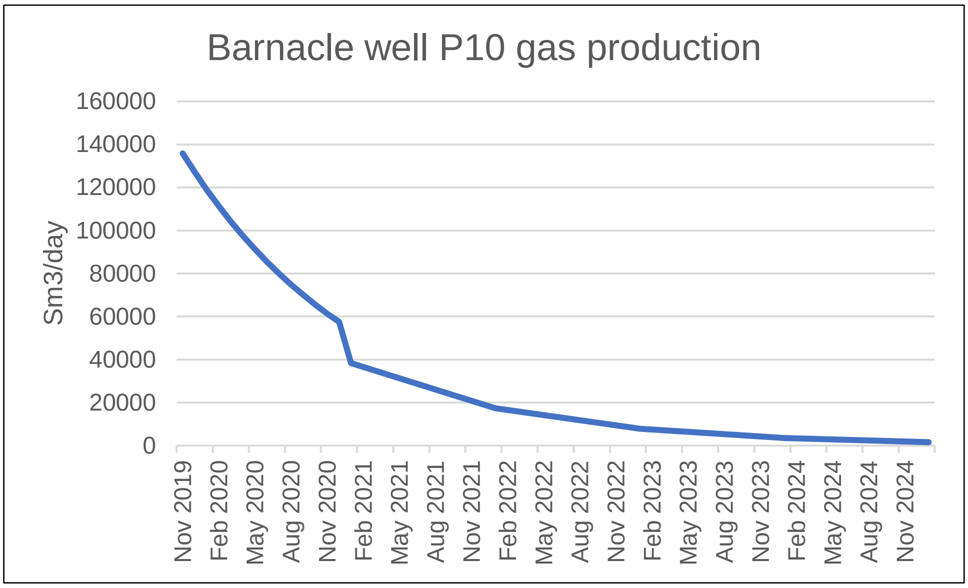

Figure 2.4 Barnacle well P10 gas production forecast.

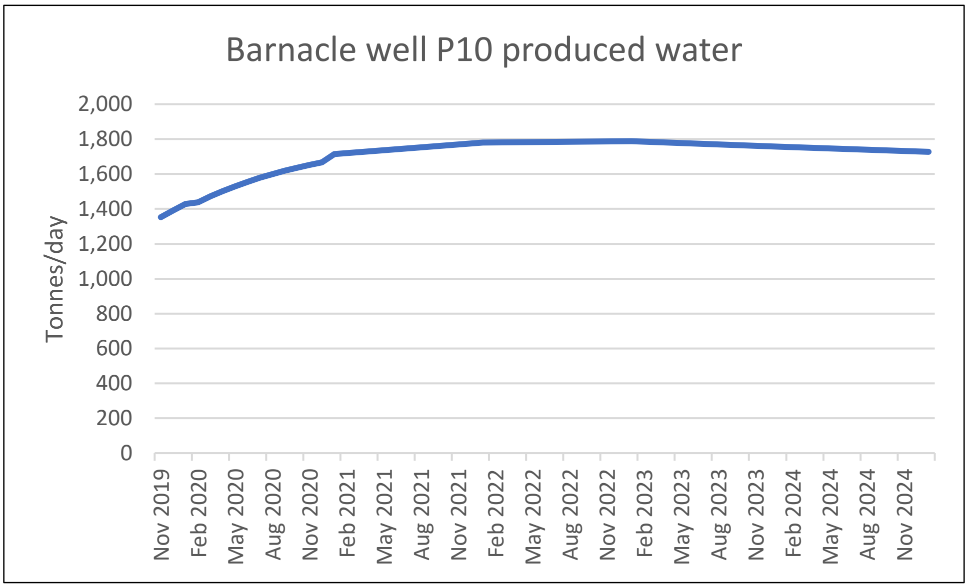

Figure 2.5 Barnacle well P10 produced water forecast.

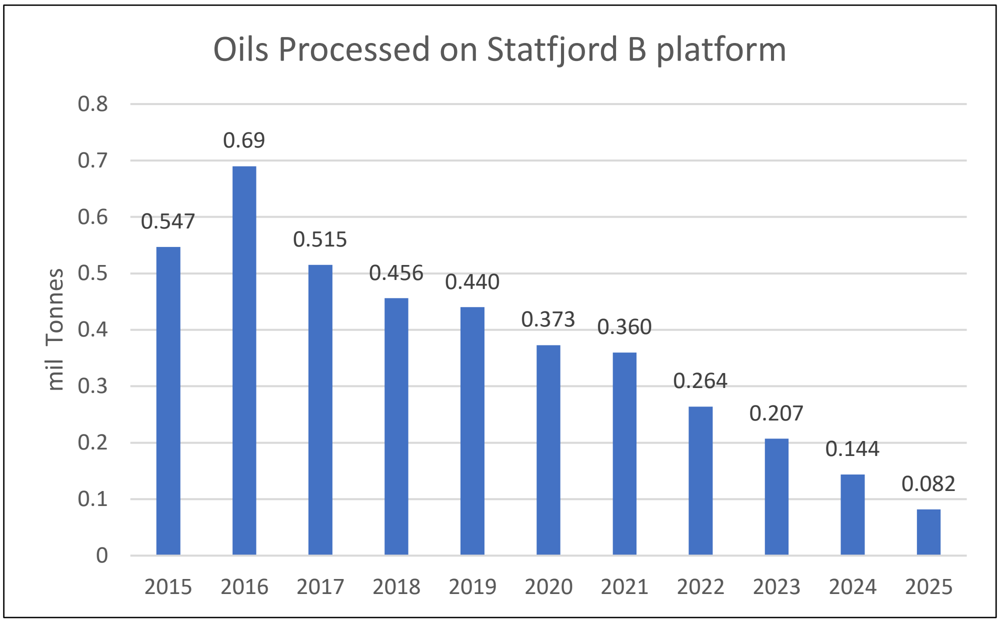

Figure 2.6 Current and projected production on Statfjord B platform, 2015 – 2025

2.10.2 Produced water

The predicted produced water production profiles are presented in Table 2.4 and is expected to peak in 2023. Discharge of produced water and chemical content is regulated by the Norwegian Environment Agency which issues permits to discharge chemicals under the Norwegian Pollution Control Act. These discharges are also regulated internationally through the Convention for the Protection of the Marine Environment of the North-East Atlantic (the OSPAR Convention, in Norwegian). In 2017 the mean monthly concentration of oil in water discharged in produced water from Statfjord B was 10.07 mg/l (Equinor, 2018a). As Figure 2.7 shows, there will be a slight increase in produced water with the inclusion of the Barnacle well fluids in 2019. However, the overall future trend will be decreasing volumes of produced water discharged into the marine environment.

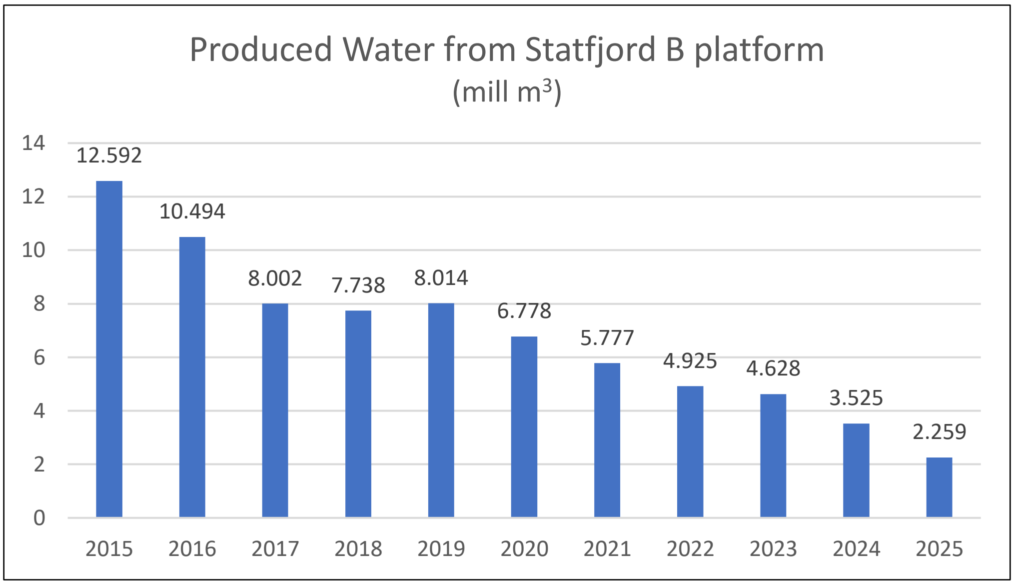

Figure 2.7 Current and projected produced water production on Statfjord B platform, 2015 – 2025

2.11 Decommissioning

As the Barnacle Field will be drained from a single well from the Statfjord B platform within the Norwegian sector, there will be no subsea infrastructure in the UKCS. Therefore, there is no UKCS decommissioning requirement, and, the well abandonment will form part of the Statfjord B platform abandonment and decommissioning plan. Financial provisions for this well abandonment will be covered under the tie-in agreement.

3 ENVIRONMENTAL BASELINE

This section describes the environmental setting of the proposed area within which the Barnacle field development activities will occur. In addition, it identifies those components of the physical, chemical and biological environments that might be sensitive to the potential impacts as a result of the proposed activities. An understanding of the environmental sensitivities at both the local and regional level informs the assessment of environmental impacts and risks associated with the project's activities.

The Barnacle Field is located within the northern part of UKCS Blocks 211/29f and 211/30c in the NNS. Drilling of the well will take place in the NCS from the Statfjord B platform within Block 33/9. Water depth is approximately 149 m. As discussed, the field development will take place from the NCS. Information for this section is from a number of published sources, most of which are for the Norwegian sector. There is currently no site-specific survey for the Statfjord B platform.

3.1 Physical environment

The general characteristics of the bathymetry, hydrodynamics (currents, tides and waves), meteorology, sea temperature, salinity and seabed sediments in the area around the Barnacle Field and Statfjord B are presented in the following subsections.

3.1.1 Bathymetry

The North Sea is a large shallow sea with a surface area of around 750,000 km^2. Water depths gradually deepen from south to north (DTI, 2001; DECC, 2016). The NNS region has a depth ranging from 100 m at the southern point in the Fladen/ Witch Ground to as deep as 1,500 m in the Faroe-Shetland Channel. Water depth at the Statfjord B platform is 149 m below lowest astronomical tide (LAT) (Equinor, 2018b; Figure 3.1). The seabed is almost flat, with a gentle downward slope to the northwest at a gradient of less than 0.5°.

3.1.2 Tides, currents and waves

The anti-clockwise movement of water through the North Sea and around the NNS region originates from the influx of Atlantic water, via the Fair Isle Channel and around the north of Shetland, and the main outflow northwards along the Norwegian coast (DECC, 2016; Figure 3.1). Against this background of tidal flow, the direction of residual water movement in the NNS is generally to the south or east (DTI, 2001; DECC, 2016). A smaller flow, the Fair Isle Current, follows the 100-m depth contour, entering the North Sea between the Shetland and Orkney Islands. This flow is a mixture of coastal and Atlantic water that crosses the NNS along the 100 m contour in a narrow band known as the Dooley Current, before entering the Skagerrak. Circulation in the North Sea is enhanced by the predominant south-westerly winds (NSTF, 1993).

Bottom water currents can deviate from the dominant surface water currents and show seasonal variations. In the eastern parts of the Norwegian Trench, the bottom topography causes deviation from the dominant northern flow. In the central part of the trench there are great variations in the bottom flow, but with a dominance of current flow towards the north and east. On the western slope of the Norwegian Trench, waters below 100 m have a fairly stable current flow towards south-southwest and southeast. In large areas of the central and NNS, the bottom water becomes almost motionless during summer, particularly at depths greater than 70 m, except in areas adjacent to bottom slopes.

Maximum surface tidal streams vary from 0.25 to 0.5 m/s over most of the NNS. Information for the Statfjord facilities indicate that average tidal currents in this region range from 0.10 m/s (neap tides) to 0.20 m/s (spring tides), with the major directional axis being in a north-south direction (Statoil, 2004).

The annual mean wave height at the Statfjord Field varies between 2.3 and 2.5 m (ABPmer, 2014). The seasonal variation is provided in Table 3.1.

Table 3.1 Seasonal significant wave heights at the Statfjord Field

Spring wave height	Summer wave height	Autumn wave height	Winter wave height
2.51- 2.75 m	1.5.1- 1.75 m	2.76 – 3.00 m	3.51 – 3.75 m

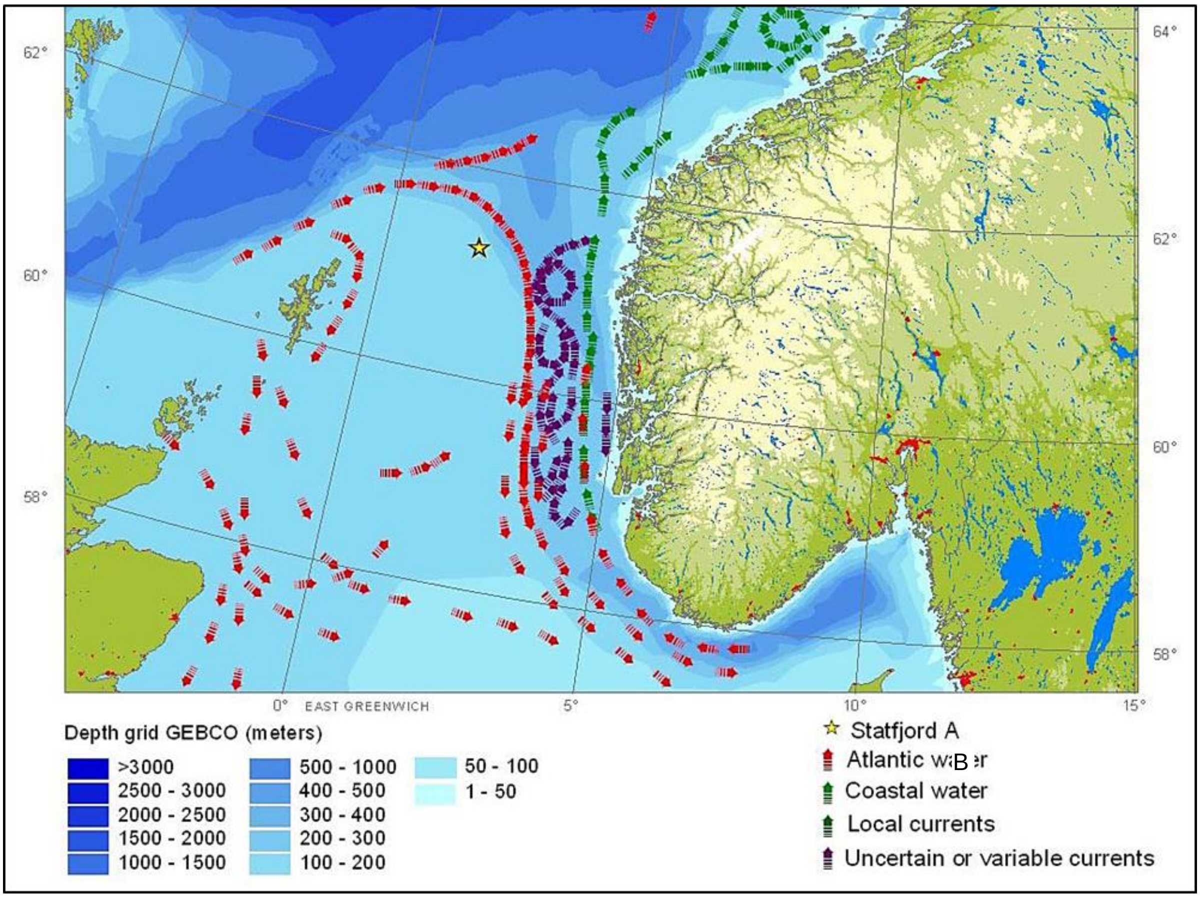

Figure 3.1 Depths and currents in the NNS (Equinor, 2018b)

3.1.3 Sea temperature and salinity

In the vicinity of the Statfjord B, water temperature is relatively uniform throughout the water column during the winter months, with a mean temperature of 7.25°C at the seabed and 7.75°C at the sea surface (UKDMAP, 1998). Over the spring and summer months, the increase in solar radiation can result in a thermocline, which separates an upper, warmer, less dense surface layer (mean temperature 13.25°C; UKDMAP, 1998) from the denser, cooler water below (mean temperature 8°C; UKDMAP, 1998). Distinct density stratification occurs in the NNS region in summer at a depth of around 50 m and the thermocline becomes increasingly distinct towards deeper water in the north of the region (DECC, 2016). During the autumn, surface cooling and an increase in storm and gale frequency promotes vertical mixing, breaking down the thermocline and creating a uniform water column.

In the open waters around the Statfjord B platform seasonal changes in sea surface salinity are comparatively small, which is typical of the open waters of the North Sea (OSPAR, 2000). Winter surface salinity in the area is approximately 35.2 parts per thousand (ppt) while the summer surface salinity ranges between 35 to 35.25 ppt. Seasonal changes are also minor at the seabed, varying between 35.2 ppt in the winter to 35 to 35.25 ppt in the summer months (UKDMAP, 1998).

3.1.4 Wind

Winds in the Statfjord B area are characterised by large seasonal variations in direction and speed, although there are intra-seasonal trends in both wind direction and speed. Winds in this region of the North Sea originate most frequently from south to south-westerly directions (Figure 3.2). Predominant wind speeds throughout the year represent moderate to strong breezes (approximately 6 to 13 m/s). Winds greater than Force 7 (28 m/s) occur most frequently during the winter months (September to March), and may originate from any direction. Wind speeds during the summer months (April to August) are generally lower, with dominant wind speeds ranging between Force 4 and Force 6 (5 to 14 m/s) and winds originating from north and north-easterly directions more frequent and sometimes predominate at this time of year (Shell, 2012).

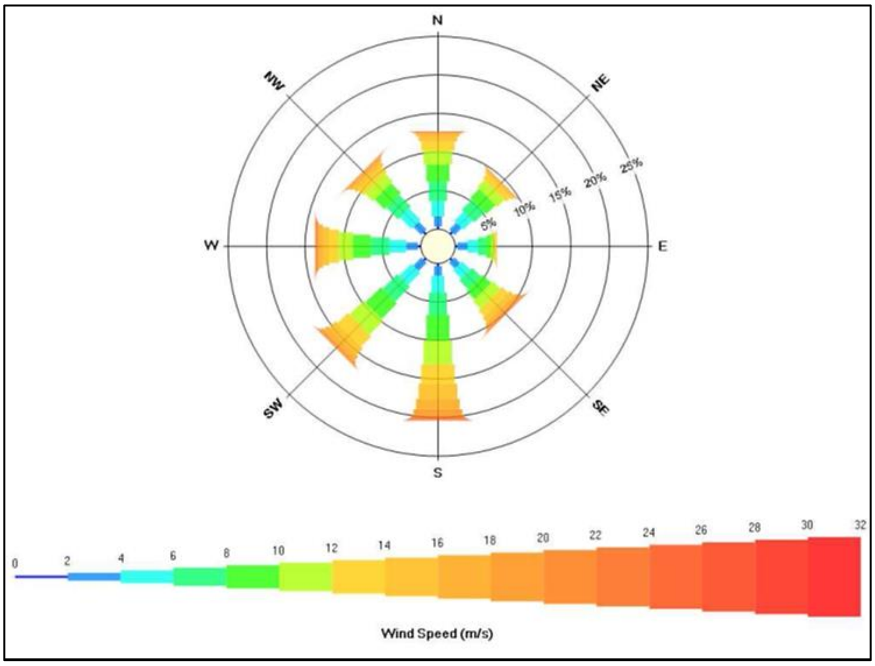

Figure 3.2 Annual mean wind rose at 10 m above sea level for the Brent Field area, located 10 km to the south of the Statfjord B platform.

3.1.5 Seabed sediments

On a regional scale, this area of the NNS is classified as predominantly deep circalittoral sand, with localised areas of deep circalittoral coarse sediment (Figure 3.3). The sediment in the vicinity of Statfjord B is dominated by sand (average 90.3%) and with a low organic content (average 1.5%) which corresponded to the regional stations in the shallow sub-region (average 1.4%).

The physical, chemical and biological status of the seabed across Region IV of the NCS and which encompasses Statfjord B is regularly examined as part of the regional environmental surveys undertaken by the Norwegian Government, with the last survey conducted in 2017 (Mannvik and Wasbotten, 2018). The survey funded by the Norwegian oil and gas industry includes a wide range of oil and gas fields including Statfjord. The findings are compared to eight previous surveys, providing a means to identify contamination and/or changes to the benthic fauna and communities. For the region as a whole, the 2017 survey concluded that there is a decrease in sediment area contaminated with total hydrocarbon concentration (THC) above 50 mg/kg, from ~7.08 km^2 in 2014 to ~5.31 km^2 in 2017. The major single contribution to the decrease in the maximum area was at Statfjord B, with a contaminated area of ~113.1 km^2 in 2014 to ~1.57 km^2 in 2017. Throughout the assessment of the results for the biological characteristics of the region from the different analyses carried out on the data from each field, the fauna at each station were evaluated to identify faunal disturbance. The total area of disturbed fauna at each field and the region as a whole was evaluated. No additional faunal disturbance was recorded at Statfjord B.

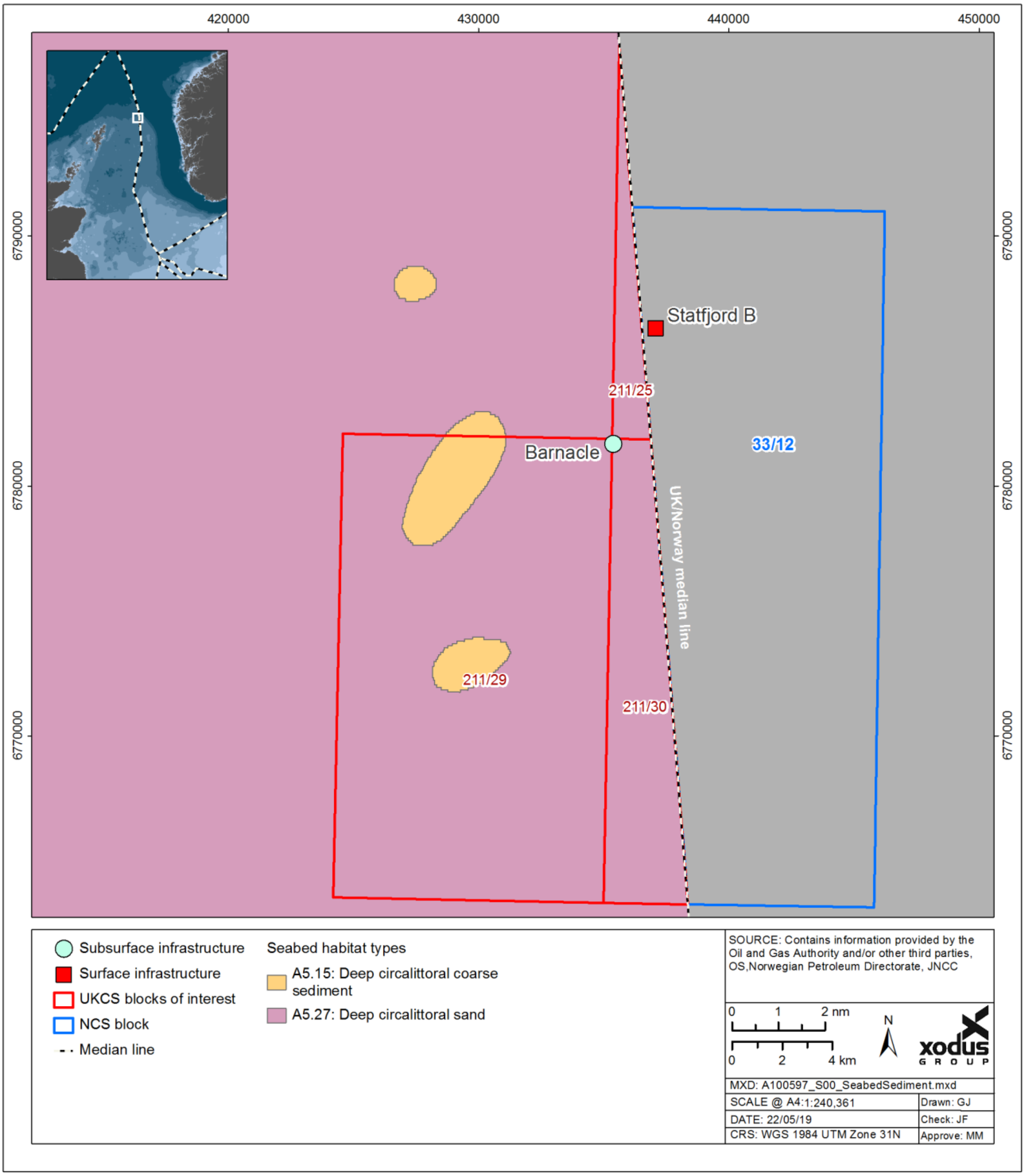

Figure 3.3 Regional seabed sediment distribution adjacent to, and including, the Barnacle well and Statfjord B platform.

3.2 Biological environment

Understanding the main biological characteristics within the area provides a basis to assess sensitivities and potential environmental impact that may arise from the proposed project. This section summarises the characteristics of plankton, benthos, finfish and shellfish spawning and nursery grounds, marine mammals, seabirds and offshore conservation areas relevant to Statfjord B and the Barnacle well.

3.2.1 Plankton

Plankton form a fundamental link in the food chain and vary seasonally in community structure according to temperature, water column mixing and nutrient availability. They are defined as small plants (phytoplankton) and animals (zooplankton) which live freely in the water column and move passively with the water currents.

Within the NNS, the phytoplankton community is dominated by the dinoflagellate genus *Ceratium* and specifically *C. fusus, C. furca* and *C. lineatum.* The diatoms *Thalassiosira* spp. and *Chaetoceros* spp. are also abundant within these waters. Copepods dominate the zooplankton community in terms of both biomass and productivity and particularly the *Calanus* spp. This species are large crustaceans which are an important prey species for higher trophic level groups. The colder waters of the NNS suit *C. finmarchicus*, with other abundant groups being *Paracalanus* spp. and *Pseudocalanus* spp. The zooplankton assemblage is also composed of *Acartia* spp., euphausiids and decapod larvae (OESEA3, 2016).

3.2.2 Benthic fauna and habitats

Benthic fauna comprises species which live either within the seabed sediment (infauna) or on its surface (epifauna). Such species, which may be either sedentary or motile and may encompass a variety of feeding habits (e.g., filter-feeding, predatory or deposit-feeding), occupy a variety of different niches. Benthic fauna are also typically divided into categories, principally according to size. The largest are the megafauna and this group comprises animals, usually living on the seabed, which are large enough to be seen in bottom photographs and caught by trawl (i.e., brittle stars, sea urchins, sea cucumbers, sea spiders, sponges and corals). Macrofauna are defined as those animals larger than 500 µm. Meiofauna comprises the smaller interstitial animals (mainly nematode worms and harpacticoid copepods) with a lower size limit of between 45 µm and 62 µm (Kennedy and Jacoby, 1999).

Benthic infauna within the adjoining area of the Statfjord B showed diverse benthic communities indicative of undisturbed conditions, typical of the East Shetland Basin. Benthic infauna were found to be dominated by polychaetes, molluscs and crustaceans and an epifauna dominated by echinoderms and crustaceans (IOE, 1990d). Data from benthic surveys UKCS Block 211/29 indicate that characteristic infaunal species associated with this region of the North Sea include the polychaetes *Myriochele* spp. and *Owenia fusiformis*, and *Thyasira* spp (UKOOA, 2000). The epifauna of the project area can be characterised by the hermit crab *Pagurus bernharus*, the crustacean *Crangon allmani*, the purple heart urchin *Spatangus purpureus* and the mollusc *Colus gracilis* (Statoil, 2004).

The most recent NCS Region IV environmental survey recorded a total of 166,737 individuals from 817 taxa from the 221 stations in 2017 (juveniles are not included). Polychaetes dominated the fauna with 71% of the total number of individuals and 50% of the total number of taxa recorded. The range and mean values of the number of individuals and taxa and the Shannon diversity index at the regional stations and the fields in Region IV in 2017 are shown in Figure 3.4. The high occurrence of the polychaetes *Capitella capitata* at Statfjord B (489 individuals) gave low diversity at this station. *Capitella capitata* occur in high numbers in sediment with high levels of THC. In general, there were large variations in the number of individuals per station, taxa, and diversity over the Statfjord Field. The monitoring results from a sampling station 1,000 m southwest of the Statfjord B and close to the UK/ Norway median line in the Brent area, are assumed to be representative of a typical, unaffected environment in this area (Mannvik and Wasbotten, 2018).

Biotope type around the Barnacle well location and Statfjord B is classified according to the nature and distribution of the sediment found in the area, based on the EUNIS (European Nature Information System) biotope classification system (Scottish Government, 2018a). The most probable biotopes identified within

Blocks 211/29, 211/30 and 33/9 are EUNIS A5.27, Deep Circalittoral Sand, (comparable to the Joint Nature Conservation Committee (JNCC) classification of SS.SSa.OSa, Offshore Circalittoral Sand) and A5.15, Deep Circalittoral coarse sand, (comparable to SS.SCS.OCS, Offshore Circalittoral Coarse Sediment) (Connor et al., 2004).

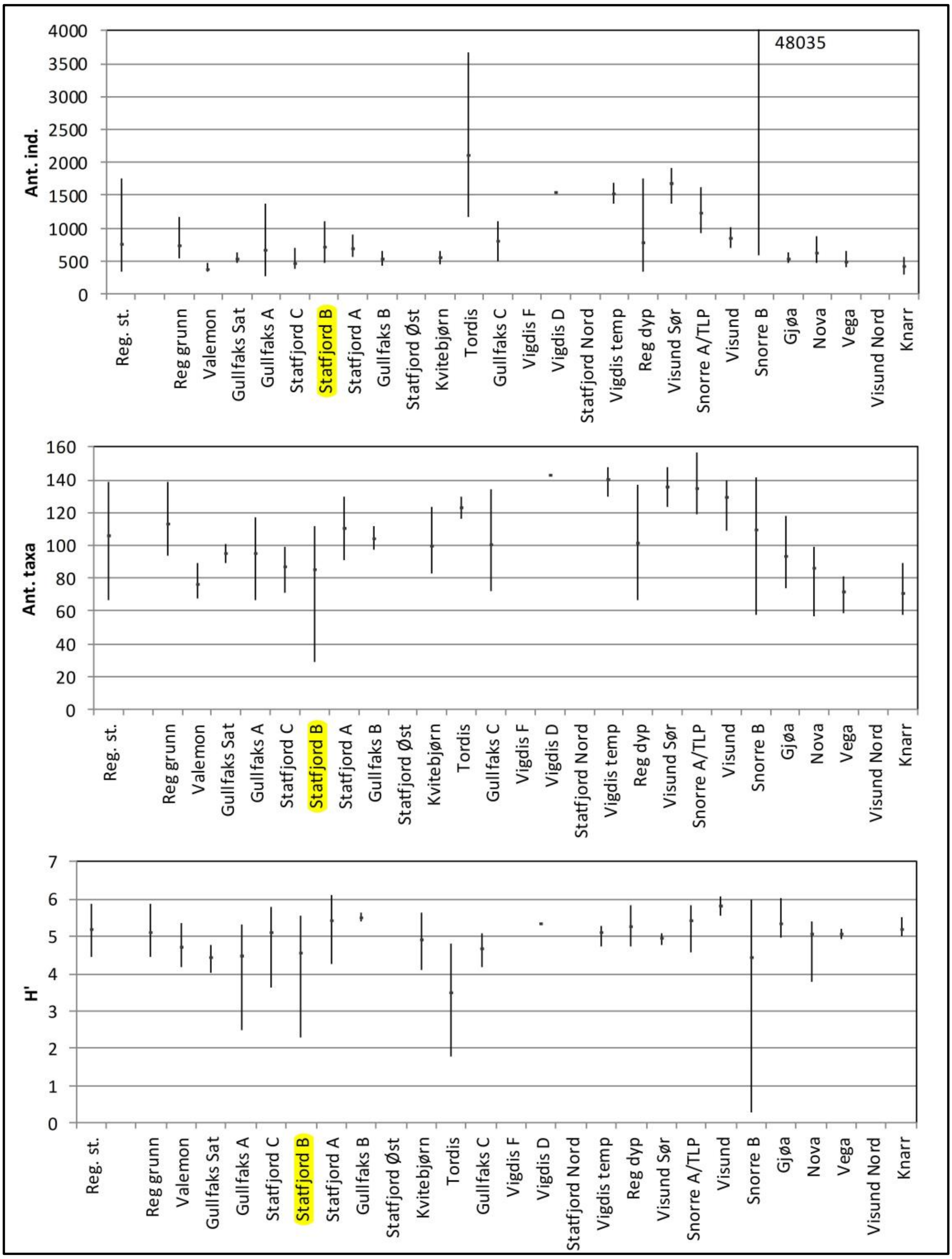

Figure 3.4 **The range and average values of the number of individuals and taxa and the Shannon diversity indices (H') at the Statfjord Field in Region IV, 2017.**

3.2.3 Fish and shellfish

Adult and juvenile stocks of finfish and shellfish can be categorised into pelagic and demersal finfish and shellfish.

- Pelagic species occur in shoals swimming in mid-water, typically making extensive seasonal movements or migrations between sea areas. Examples of pelagic species include herring, mackerel, blue whiting and sprat.
- Demersal species live on or near the seabed and include cod, haddock, plaice, sandeel, sole, and whiting.
- Shellfish species are demersal (bottom-dwelling) molluscs, such as mussels and scallops, and crustaceans, such as shrimps, crabs and Nephrops (Norway lobster).

Generally, there is little negative interaction between fish species and offshore oil and gas developments. It has been demonstrated that some species will be attracted to and aggregate around man-made structures (Jørgensen et al., 2002). Some fish and shellfish species are, however, vulnerable to offshore oil and gas activities, such as discharges to sea (CEFAS, 2001). The most vulnerable period for fish species is during the egg and juvenile stages of their life cycles. Fish that lay their eggs on the sediment (e.g., herring and sandeel) or which live in intimate contact with sediments (e.g., sandeel and most shellfish) are susceptible to smothering by discharged solids (Coull et al., 1998).

The Barnacle Field is located in International Council for Exploration of the Sea (ICES) rectangle 51F1, in an area of spawning and nursery grounds for several commercially important species. Information on spawning and nursery periods for these species, including peak spawning times (where applicable) is presented in Table 3.2 based on data in Coull *et al*. (1998) and Ellis *et al*. (2012). The Barnacle well and Statfjord B platform lie within spawning grounds for whiting (*Merlangius merlangus;* February to June), cod (*Gadus morhua;* January to April), saithe (*Pollachius virens*; January to April), Norway pout (*Trisopterus esmarkii*; January to April), herring (*Clupea harengus*; August to January) and haddock (*Melanogrammus aeglefinus*; February to May) and within nursery grounds for haddock, Norway pout, spur dog (*Squalus acanthias*), ling (*Molva molva*), hake (*Merluccinus merluccinus*), anglerfish (*Lophius piscatorius*), ling (*Molva molva*), sprat (*Sprattus sprattus*), plaice (*Pleuronectes platessa*), mackerel (*Scomber scombus*), blue whiting (*Micromesistius poutassou*).

Table 3.2 Spawning and nursery grounds within ICES rectangle 51F1.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Anglerfish[1]	N	N	N	N	N	N	N	N	N	N	N	N
Cod[1and 2]	S	S*	S*	S								
Whiting[1and 2]		S	S	S	S	S						
Norway pout[1]	S N	S* N	S* N	S N	N	N	N	N	N	N	N	N
Haddock[1]	N	S* N	S* N	S* N	S N	N	N	N	N	N	N	N
Saithe[1]	S*	S*	S	S								
Herring[2]	S N	N	N	N	N	N	N	S N	S N	S N	S N	S N
Hake[1]	N	N	N	N	N	N	N	N	N	N	N	N
Ling[2]	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel[2]	N	N	N	N	N	N	N	N	N	N	N	N
Sprat[1,3]	N	N	N	N	N	N	N	N	N	N	N	N
Spur dog[2]	N	N	N	N	N	N	N	N	N	N	N	N
Plaice[3]	N	N	N	N	N	N	N	N	N	N	N	N
Blue whiting[1]	N	N	N	N	N	N	N	N	N	N	N	N

Key: *Period of intense spawning activity; S=spawning area; N=nursery area. Source: [1]Coull *et al*. (1998), [2]Ellis *et al*. (2010); Aires *et al* (2014)

Fish spawning (Figure 3.5) and nursery locations (Figures 3.6 and 3.7) are based on data provided by the industry-commissioned Fisheries Sensitivity Maps in British Waters and Defra-commissioned reports mapping the spawning and nursery grounds of selected fish species (Coull *et al*., 1998; Ellis *et al*., 2010). The information provided in these figures represents the widest known spawning and nursery distribution given present knowledge and should not be seen as a fixed, unchanging description of presence or absence of a species (Coull *et al*., 1998; Ellis *et al*., 2010). Figures 3.6 and 3.7 also presents data from Aires *et al*. (2014) showing the probability of aggregations of “0 group” fish (fish in the first year of their lives), including where these are not captured as nursery areas in the older data.

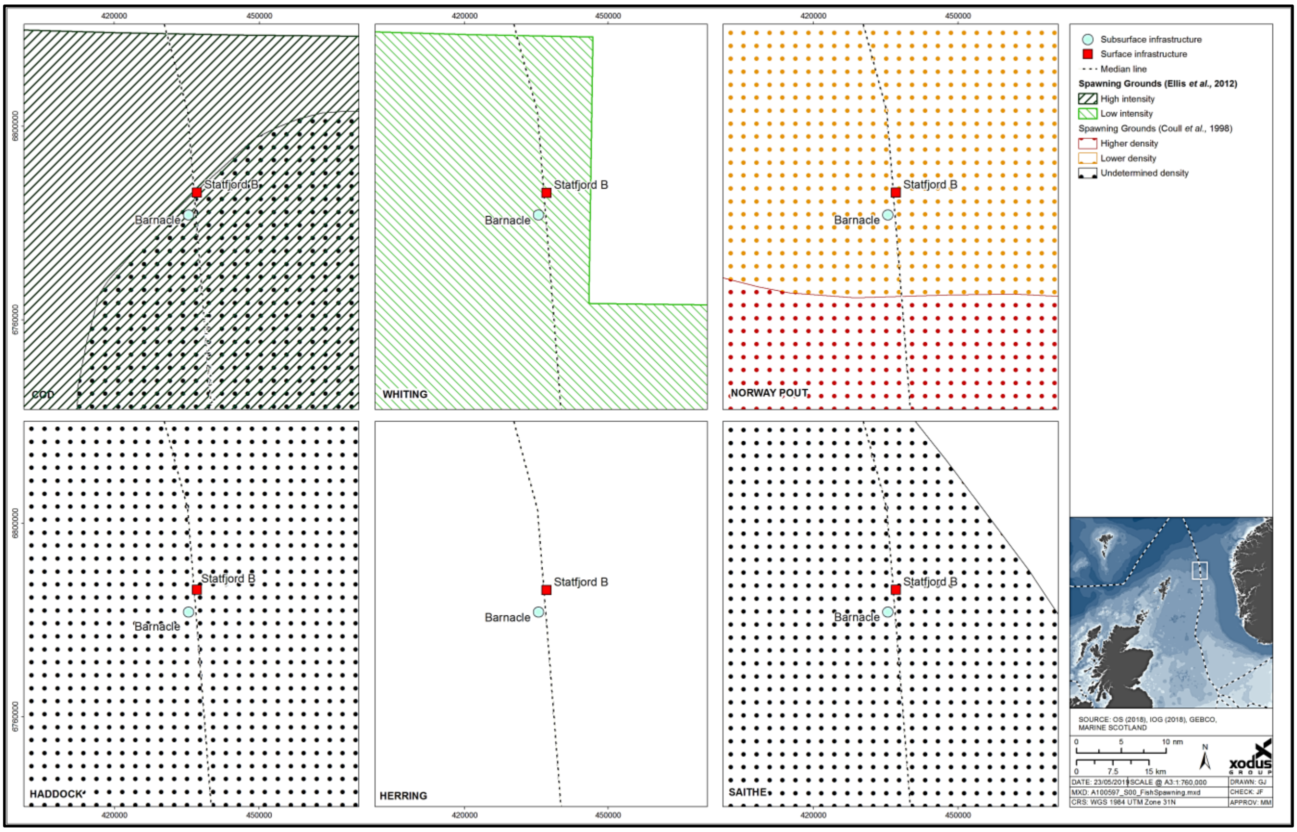

Figure 3.5 Spawning grounds for cod, whiting, Norway pout, haddock, herring and saithe.

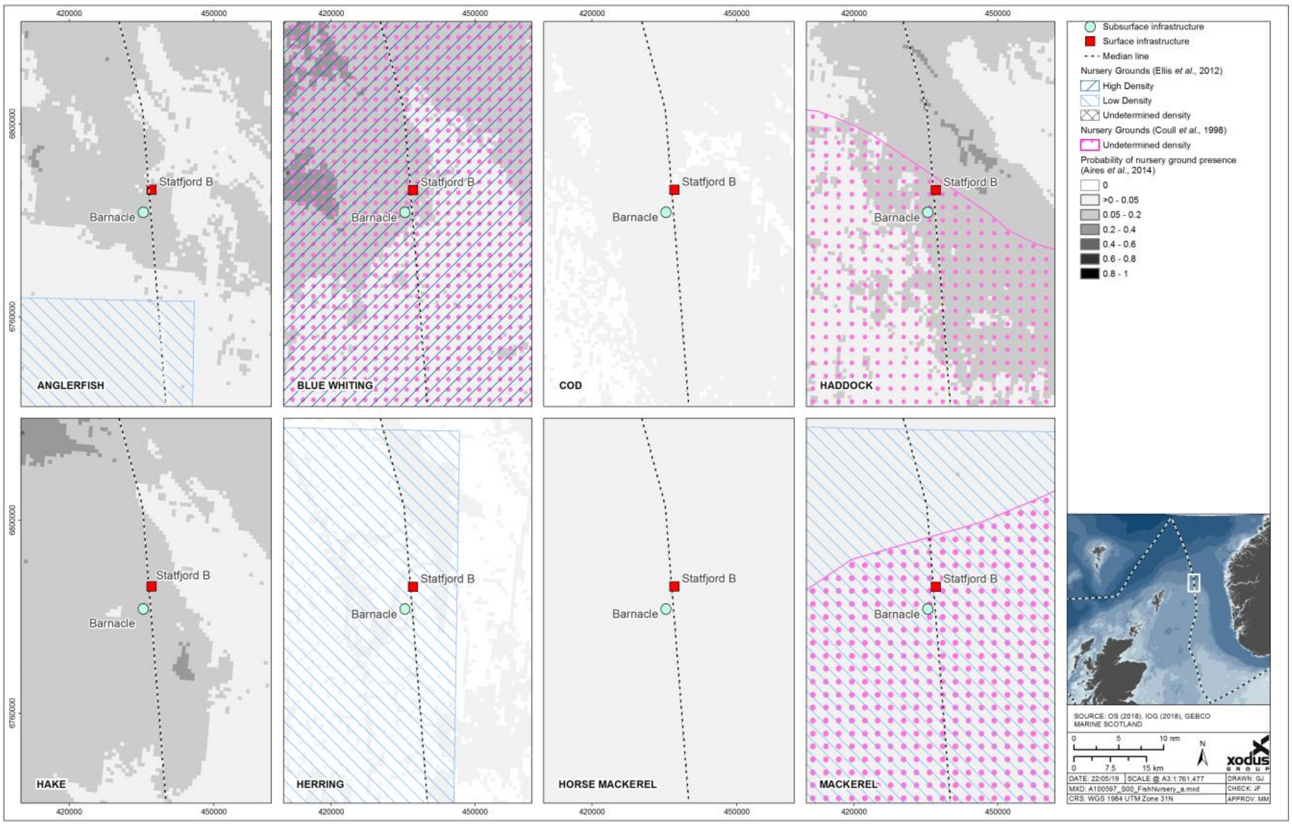

Figure 3.6 **Nursery grounds for anglerfish, Blue whiting, cod, haddock, hake, herring, horse mackerel, and mackerel.**

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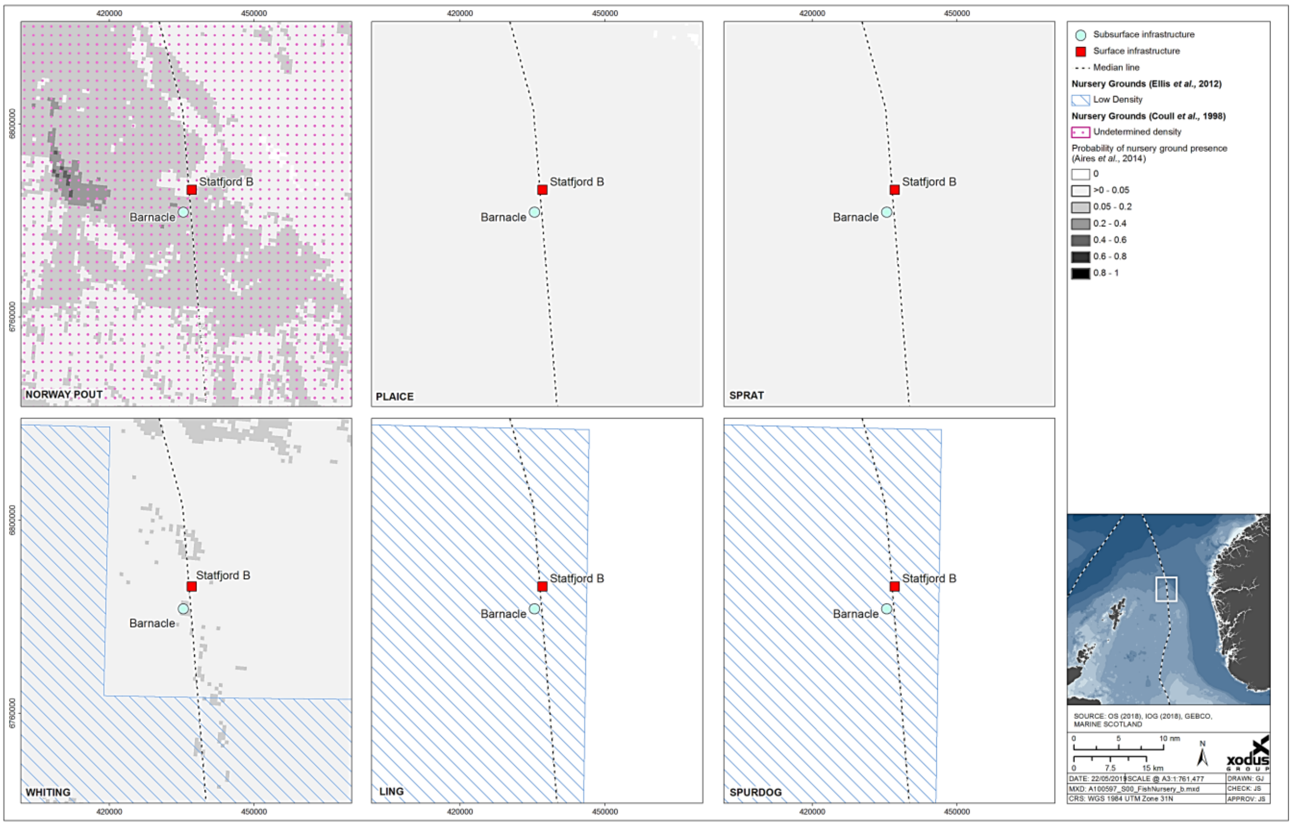

Figure 3.7 Nursery grounds for Norway pout, place, sprat, whiting, ling and spurdog.

3.2.4 Seabirds

Much of the North Sea and its surrounding coastline and offshore waters are internationally important breeding and feeding habitats for seabirds. In the NNS, the most numerous species likely to be northern fulmars (*Fulmarus glacialis*), black legged kittiwakes (*Rissa tridactyla*) and common guillemots (*Uria aalge*) (DECC, 2009; DECC, 2016). Seabirds are not normally affected by routine offshore oil and gas operations. In the unlikely event of an oil release, however, birds are vulnerable to oiling from surface pollution, which could cause direct toxicity through ingestion, and hypothermia as a result the birds' inability to waterproof their feathers. Birds are more vulnerable in the moulting season when they become flightless and spend a large amount of time on the water surface. Some species become flightless during the moulting season, (particularly auk species such as Common Guillemot, Razorbill (*Alca torda*) and Atlantic Puffin).

Additional species commonly found in North Sea offshore waters are fulmar (*Fulmarus glacialis*), gannet (*Morus bassanus*), and razorbill (*Alca torda*); and herring (*Larus argentatus*), great black-backed (*Larus marinus*) and lesser black-backed (*Larus fuscus*) gulls (DTI, 2001). Other species which are recorded at lower levels include the pomarine skua (*Stercorarius pomarinus*), Arctic skua (*Stercorarius parasiticus*), black-headed gull (*Larus ridibundus*), common gull (*Larus canus*), common tern (*Sterna hirundo*), Arctic tern (*Sterna paradisaea*), little auk (*Alle alle*), and puffin (*Fratercula arctica*) (DTI, 2001).

The following seabird species breed regularly in and around the North Sea coastlines including Norway (DTI, 2001; Kober *et al*., 2010).

- Four species of petrel; fulmar, Manx shearwater (*Puffinus puffinus*), storm petrel (*Hydrobates pelagicus*) and Leach's petrel (*Oceanodroma leucorhoa*);
- Two species of cormorant: cormorant (*Phalacrocorax carbo*) and shag (*Phalacrocorax aristotelis*);

- Northern gannet;
- Two species of skua: great skua (*Catharacta skua*) and Arctic skua;
- Six species of gull: herring gull, common gull (*Larus canus*), black-headed gull (*Larus ridibundus*), lesser black-backed gull, great black-backed gull and kittiwake;
- Five species of tern: Sandwich tern (*Sterna sandvicensis*), roseate tern (*Sterna dougallii*), common tern, Arctic tern and little tern (*Sterna albifrons*); and
- Four species of auk: guillemot, razorbill, black guillemot (*Cepphus grylle*) and puffin.

The Seabird Oil Sensitivity Index (SOSI) is a tool which aids planning and emergency decision making with regards to oil pollution (Webb *et al*., 2016). It is an updated version of the Oil Vulnerability Index (JNCC, 1999) as it uses survey data collected between 1995 and 2015 and includes an improved method to calculate a single measure of seabird sensitivity to oil pollution. The survey area covers the UKCS and much of the Norwegian sector. These data were combined with individual species sensitivity index values and summed at each location to create a single measure of seabird sensitivity to oil pollution (Webb *et al*., 2016). The index is independent of where oil pollution is most likely to occur; rather it indicates where the highest seabird sensitivities might lie if there were to be a pollution incident. The SOSI for Blocks 211/29, 211/30 and surrounding blocks is shown in Table 3.3, and illustrated in Figures 3.8 and 3.9. Block/ month combinations that were not provided with data have been populated with the SOSI using the indirect assessment method provided by Webb *et al*. (2016). Throughout the year, based on the seabird sensitivity to oil pollution ranges from low to medium (Table 3.3).

Table 3.3 Seabird sensitivity in Block 22/29 and 211/30, and surrounding blocks

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All
211/23	5	5	5	5		5	5	5	5	5	3	3	4
211/24	5	5	5	5		5	5	5	5	5	3	3	4
211/25	5	5	5				5	5	5			3	5
211/28	5	5	5	5		5	5	5	4	4	5	5	4
211/29	5	5	5	5		5	5	5	5	5	5	5	5
211/30	5	5	5	5		5	5	5	5			5	5
3/3	5	5	5	5	5	5	5	5	4	4	5	5	5
3/4	5	5	5	5		5	5	5	5	5	5	5	5
3/5	5	5	5	5	4	4	5	5	5			5	5
33/9	5	5	5	5		5	5	5	5	5	3	3	4
33/10	5	5	5	5		5	5	5	5	5	5	5	5
33/12	5	5	5	5		5	5	5	5	5	5	5	5
34/7	5	5	5	5		5	5	5	5	5	3	3	4
Key	**1**	**Extremely high**	**2**	**Very high**	**3**	**High**	**4**	**Medium**	**5**	**Low**	**No data**		

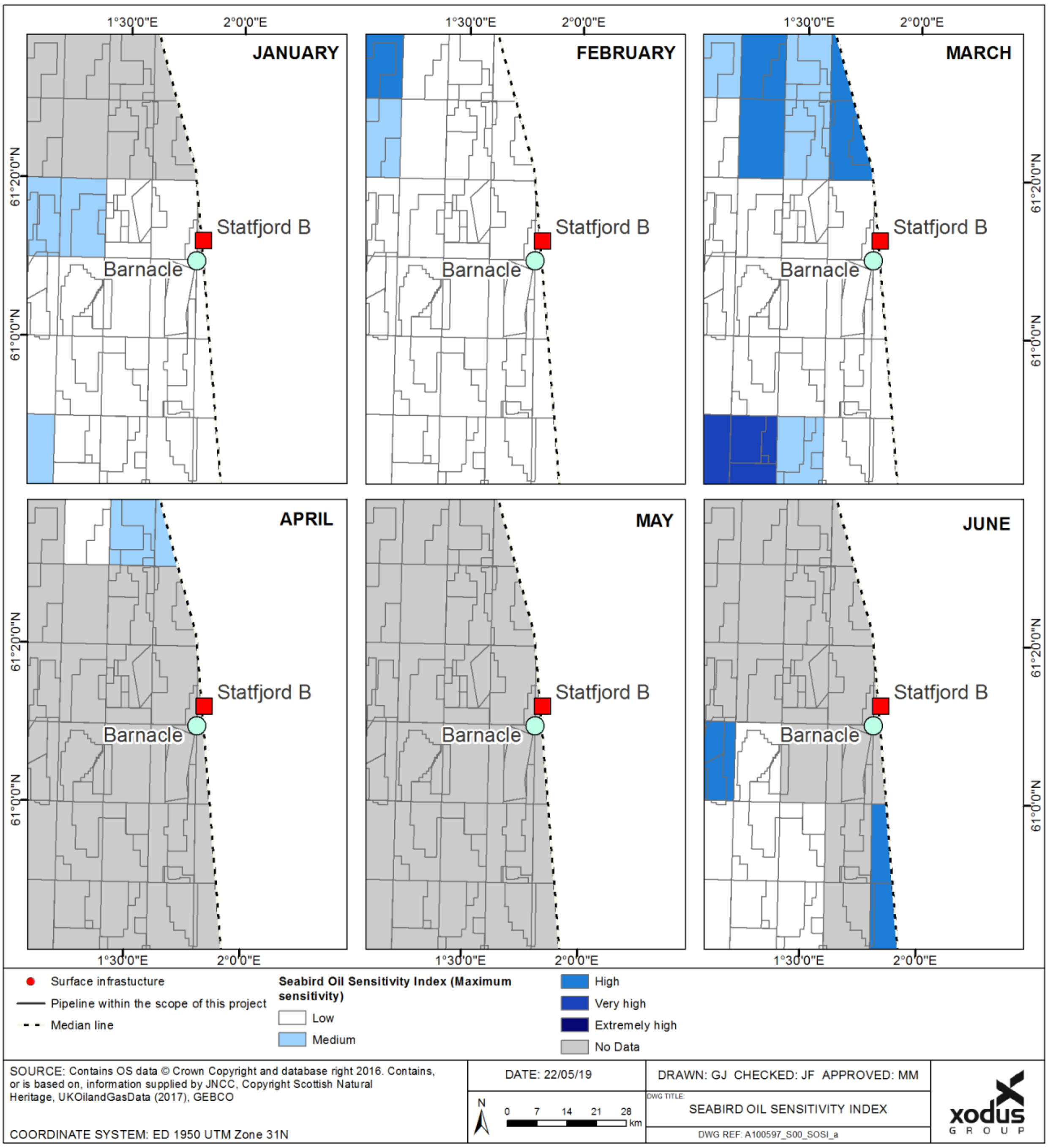

Figure 3.8 Seabird Oil Sensitivity between January and June (Webb *et al*., 2016)

Figure 3.9 Seabird Oil Sensitivity between July and December (Webb *et al*., 2016)

3.2.5 Marine mammals

Marine mammals include whales, dolphins and porpoises (cetaceans) and seals (pinnipeds). They may be vulnerable to the effects of oil and gas activities and can be impacted by noise, contaminants, oil spills and any effects on prey availability (SMRU, 2001). The abundance and availability of prey, including plankton and fish, can be of prime importance in determining the numbers and distribution of marine mammals and can also influence their reproductive success or failure. Changes in the availability of principal prey species may result in population level changes of marine mammals but it is currently not possible to predict the extent of any such changes (SMRU, 2001).

Cetaceans

The main marine mammal species occurring in the Barnacle well area and Statfjord B platform are harbour porpoise (*Phocoena phocoena*), killer whale (*Orcinus orca)*, minke whale (*Balaenoptera acutorostrata*), sperm whale (*Physeter macrocephalus*), white beaked dolphin (*Lagenorhynchus albirostris*), pilot whale *(Globicephala melas)* and white-sided dolphin (*Lagenorhynchus acutus*). The majority of sightings have taken place during spring and summer (May to August) with a few sightings of harbour porpoise, sperm whale and white-beaked dolphin also occurring during the autumn and winter (Table 3.4; UKDMAP, 1998; NMPI, 2019; Statoil, 2014).

Table 3.4 Seasonal cetacean sightings in the vicinity of the proposed Barnacle well and Statfjord B.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Harbour porpoise	3	1	3	2	3	3	1	2	3	3		2
Minke whale				3		2	1	3				
Sperm whale					3	3	3	3	3	3		
Killer whale					2	2	3	3			3	
Pilot whale						3	3	1				
White-beaked dolphin		2	2		3	3	1	3	3	3	3	
Atlantic white-sided dolphin			3		3	3	2	1				
Key: 1 = High Density, 2 = Moderate Density, 3 = Low Density, Blank = No data.												

Pinnipeds

Two species of pinnipeds (seal) are resident in UK waters, the grey seal (*Halichoerus grypus*) and the harbour or common seal (*Phoca vitulina*), both occurring regularly over large parts of the North Sea (SMRU, 2001). Both species breed in the UK, with harbour seals pupping in June and July and grey seals pupping between October and December. Both grey and harbour seals have breeding colonies in the Shetland and Orkney Islands, and along the coast of Norway. Seals can travel considerable distances (up to 60 km, but this is relatively rare) from their haul-out sites on feeding trips (Harwood and Wilson, 2001; Hammond *et al*., 2004). Grey and harbour seals are listed in Annex II of the Habitats Directive. Studies of grey and harbour seal densities in the NNS (NMPI, 2018; SMRU, 2018) indicate that the densities of grey and harbour seal species in the vicinity of the Barnacle Field are very low (0 to 1 seal per 25 km^2).

3.2.6 Offshore conservation areas

Designated conservation sites are widespread and abundant around the UK and Norwegian coastlines and in the marine environment. Numerous levels of designation exist from statutory international to local voluntary schemes. These afford differing levels of protection for habitats, species, as well as geological, cultural and landscape features. More widespread designations include the European-level Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) and the national-level Sites/ Areas of Special Scientific Interest (SSSIs/ ASSIs) (DECC, 2011). In Scottish waters Nature Conservation Marine Protected Areas (NCMPAs) are a national designation under the Marine (Scotland) Act 2010 for inshore waters and the Marine and Coastal Access Act (2009) (JNCC, 2018).

European Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive), and Directive 2009/147/EC (the Birds Directive) on the Conservation of Wild Birds (the codified version of Council Directive 79/409/EEC, as amended) are the main instruments of the European Union (EU) for safeguarding biodiversity (EC, 2003). These Directives provide for the protection of animal and plant species of European importance and the habitats which support them, particularly through the establishment of a network of protected sites. The Habitats Directive includes a requirement to establish a European network of important high-quality conservation sites that will make a significant contribution to conserving the habitat and species identified in Annexes I and II of the Directive respectively (JNCC, 2002; 2014). Habitat types listed in Annex I considered in need of conservation at a European level include:

- Sandbanks which are slightly covered by seawater all the time;
- Reefs (bedrock, biogenic and stony);
- Submarine structures made by leaking gases; and
- Submerged or partially submerged sea caves.

Species listed in Annex II occurring in offshore waters include the grey and harbour seals, bottlenose dolphin and harbour porpoise. Due to the distance from the UK and Norway mainland, it is unlikely that grey or harbour seals would be present in the area of the Statfjord B platform (Jones et al., 2013). The harbour porpoise is highly mobile and well distributed in the North Sea, including the area of the Statfjord B platform (Reid *et al*., 2003). In the North Sea, bottlenose dolphins are rarely sighted outside coastal waters; most sightings are within 10 km of land (SMRU, 2001).

There are no declared or proposed marine conservation areas within 40 km of the Barnacle Field and Statfjord B platform that may be directly affected by the proposed well (Figure 3.10). However, there are protected and potentially sensitive marine areas approximately 100 km from the development both on the UK and the Norwegian side of the border. Offshore conservation sites in the UK NNS are shown in Figure 3.9. The Pobie Bank Reef SAC, an Annex I habitat, is located approximately 102 km southwest of the Barnacle well and is the closest UK designated conservation site. The reef is composed of a combination of stony and bedrock reef and in the central section of the reef there are very large, rugged bedrock outcrops. The reef provides a habitat to an extensive community of encrusting and robust sponges and bryozoans.

The North-east Faroe-Shetland Channel NCMPA, located 133 km to the west of the project area, covers a large part of the north-eastern reaches of the Faroe-Shetland Channel in Scottish waters and is the largest designated NCMPA. The continental slope here plays an important role in funnelling ocean currents that bring valuable food and nutrients to the region, which support a wide diversity of life. The channel is believed to be a corridor for migrating marine mammals, including the fin whale and sperm whale. At depths of 400 to 600 m, the combination of seabed type and plentiful nutrients is ideal for deep-sea sponges. Below 800 m, the muddy seabed is home to those species that can tolerate the cooler Arctic-influenced waters, such as deep-sea worms. The MPA also includes several features of geological importance, including a series of deep-water mud volcanoes known as the pilot whale diapirs.

Norwegian MPAs vary from smaller areas in the fjords up to extensive areas offshore. There are more than 150 smaller areas along the Norwegian coast where local area-based management measures have been introduced. Those measures include protection of spawning grounds, restriction by gear, prohibition against fishing for specific species, and so forth. Part of the year, control and surveillance systems are established in some areas, and during that time, more specific regulations and area-based management measures may also apply (NME, 2013). The Bremanger-Ytre Sula, an area important to seabirds, is located approximately 146 km from the Barnacle Field. Figure 3.11 shows particularly valuable and vulnerable marine areas on the NCS.

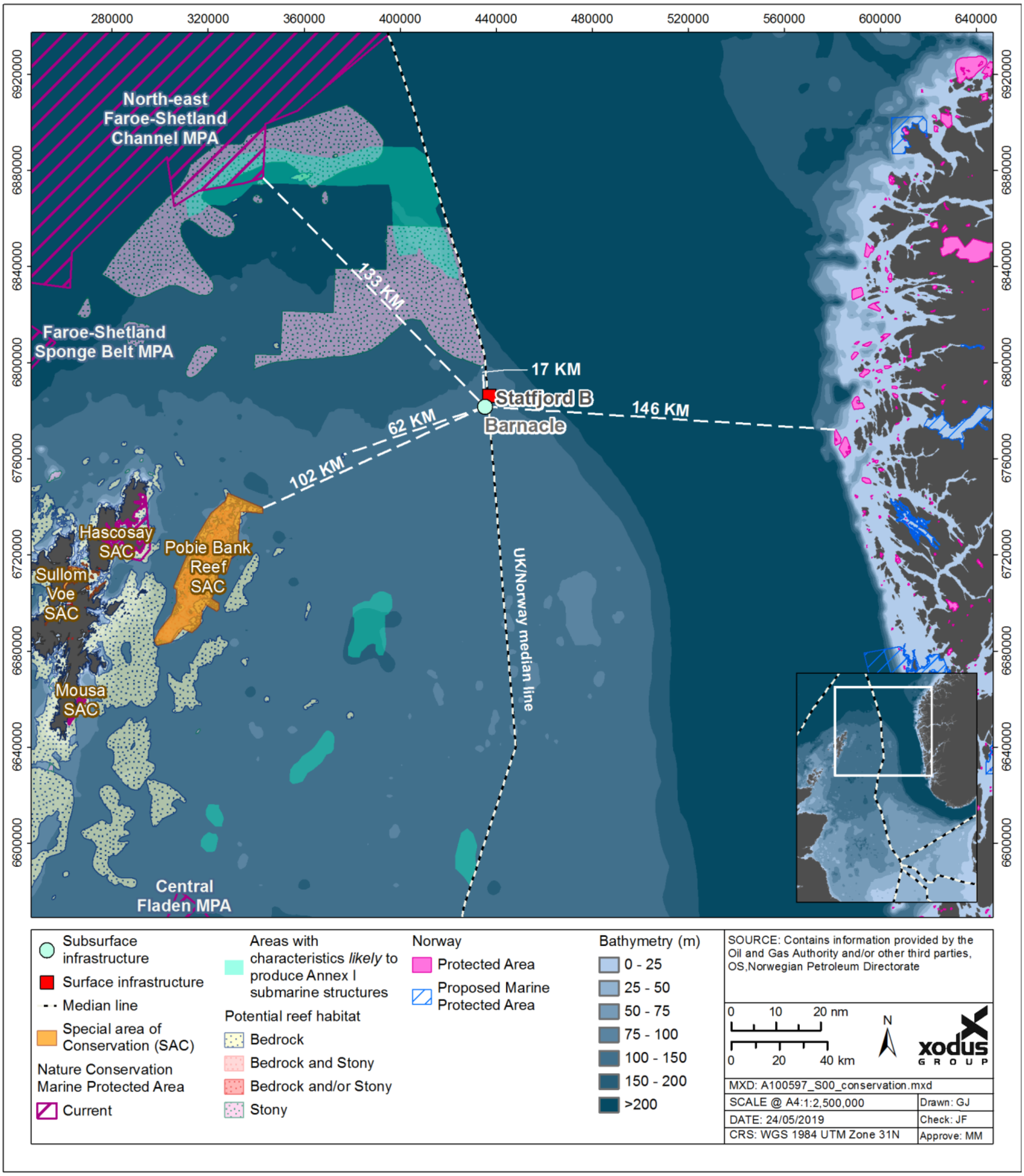

Figure 3.10 Offshore and coastal conservation sites in relation to the Barnacle well and Statfjord B platform.

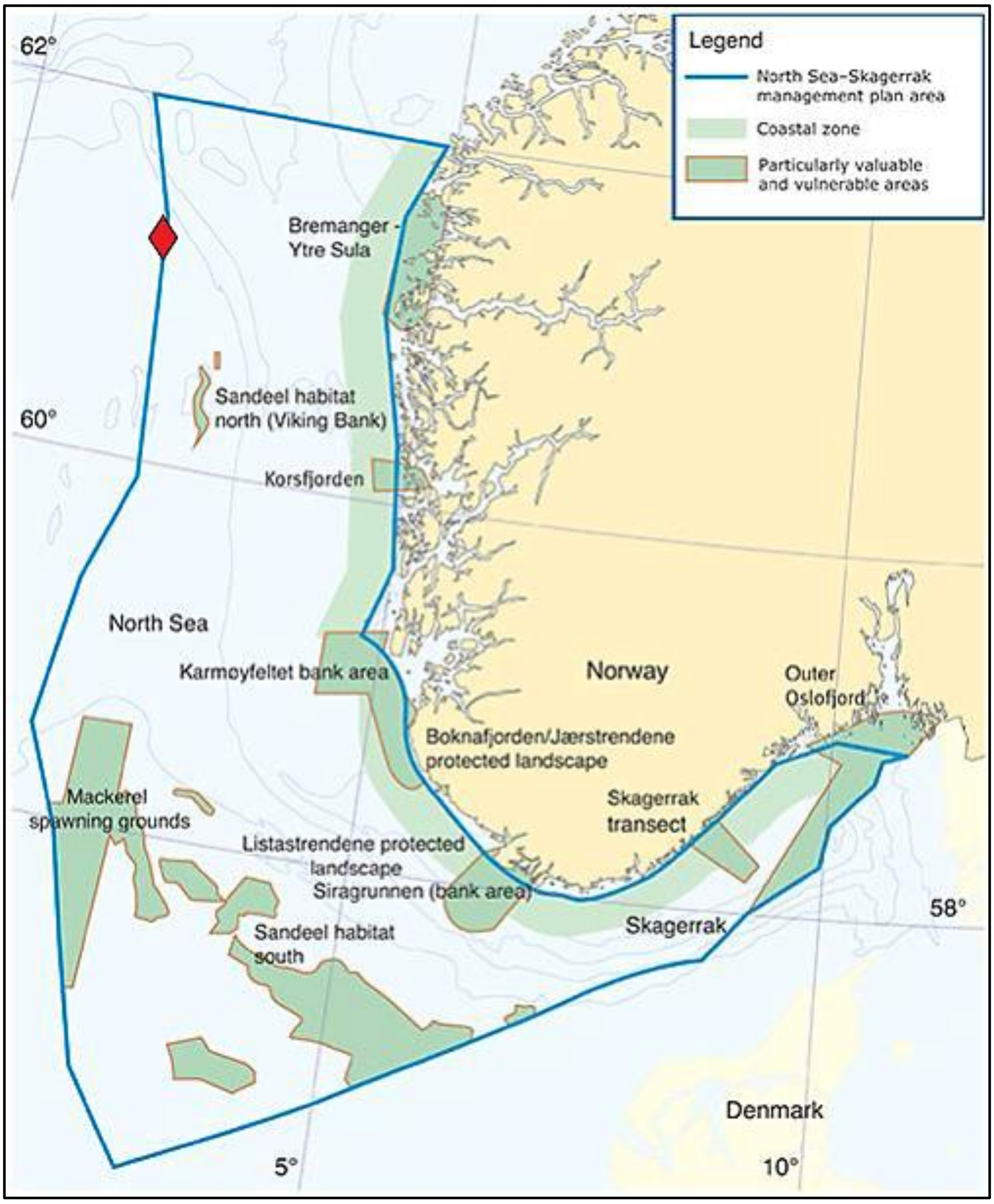

Figure 3.11 Particularly valuable and vulnerable areas in the Norwegian sector of the North Sea and Skagerrak (Source: NME, 2013). The red diamond indicates roughly the location of the well and platform.

3.3 Socio-economic environment

This section focuses on the broader socio-economic considerations of the existing baseline in relation to the proposed well. Consideration is given to the fishing and shipping industries as well as other users of the sea, such as other oil and gas installations. Since well drilling will take place from an existing platform, other users are not likely to be influenced by the proposed Barnacle well.

3.3.1 Fisheries

The North Sea has important fishing grounds and is fished throughout by both UK and international fishing fleets, targeting demersal, pelagic and shellfish stocks. An assessment of the fishing industry in the Barnacle well and Statfjord B platform area has been derived from ICES fisheries statistics for ICES rectangles 51F1. Statistical data from the ICES rectangles provide information on the UK fishing effort and live weight of demersal, pelagic and shellfish caught by all UK vessels between 2013 and 2017 (Scottish Government, 2018b).

Fishing by UK vessels and that landed in the UK from ICES rectangle 51F1 is provided in Table 3.5. The effort, value and quantity for UK vessels in 51F1 has continually decreased from 2013. In 2017 demersal fishing accounted for 98% of the UK catch landed (Table 3.6), which was below the average for UK landings.

Table 3.5 Landings by UK vessels into the UK and abroad, and foreign vessels into the UK from ICES rectangle 51F1 (Scottish Government, 2018b).

Year	Effort (Days)	Value (£)	Quantity (tonnes)
2013	182	1,407,407	1084
2014	100	1,748,346	2,067
2015	103	1,562,931	1,933
2016	62	709,983	482
2017	75	825,765	545

Table 3.6 Quantity and value of fish taken from ICES rectangle 51F1 between 2013 and 2017 (Scottish Government, 2018b)

Year	Demersal		Pelagic		Shellfish	
	Quantity (tonnes)	Value (£)	Quantity (tonnes)	Value (£)	Quantity (tonnes)	Value (£)
2013	1,084	1,406,026	<1	4	1	1,376
2014	753	948,798	1,314	799,329	<1	220
2015	525	724,269	1,404	830,843	3	7,819
2016	482	709,207	<1	12	<1	765
2017	545	824,054	0	0	1	1,711

Norwegian vessels participating in fisheries form the largest commercial fishing effort in this region, particularly for saithe, mackerel and herring. The annual Norwegian landed catch quantities in the NNS declined in the period from 2013 to 2017, although the catch value increased by 34%. Pelagic species accounted for 86% of total catch quantity and 74% of total catch value in this period. There were large variations in catches of blue whiting, herring, Norway pout and sandeel (NME, 2013). In 2018 four species, mackerel, herring, cod and saithe, contributed 50% of the landed catch out of more than 20 fish species (Figure 3.12).

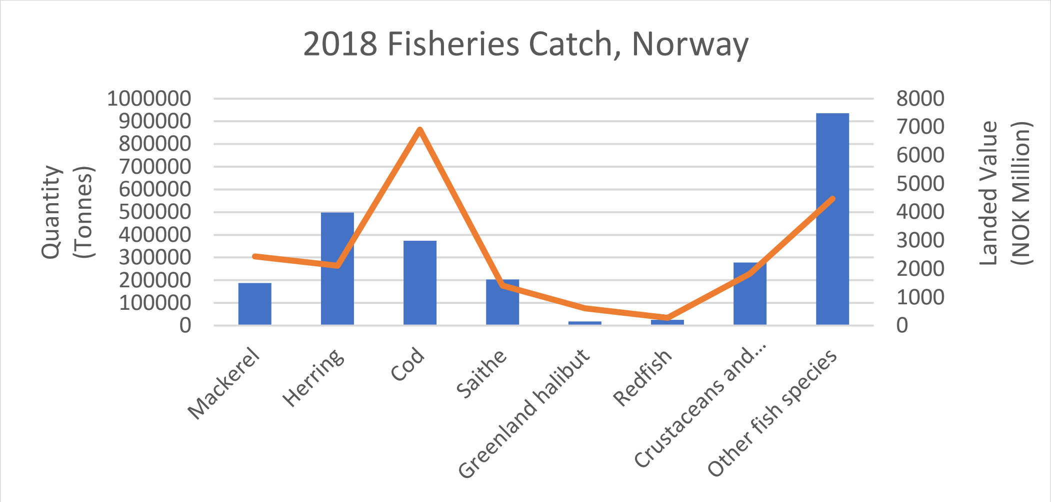

Figure 3.12 **Quantity and value of selected fish landed in Norway in 2018. Preliminary figures for catch landed by Norwegian vessels. (Statistics Norway, 2019)**

Data regarding fisheries have been taken from the Management Plan 2013 and from the Fisheries Assessment Report which was a subject report to the RIA-North Sea in 2006. Satellite tracking data from the Directorate of Fisheries around the Statfjord B platform for 2015 and 2016, shows the first quarter in 2015 high trawl activity south, west and east of Statfjord area. In the second, third and fourth quarters of 2015, trawl activity was considerably lower. Fishing activity in 2016 was similar, but showed lower activity in the first quarter than in 2015. The fishing activity in the Norwegian part of North Sea is shown in Figure 3.13.

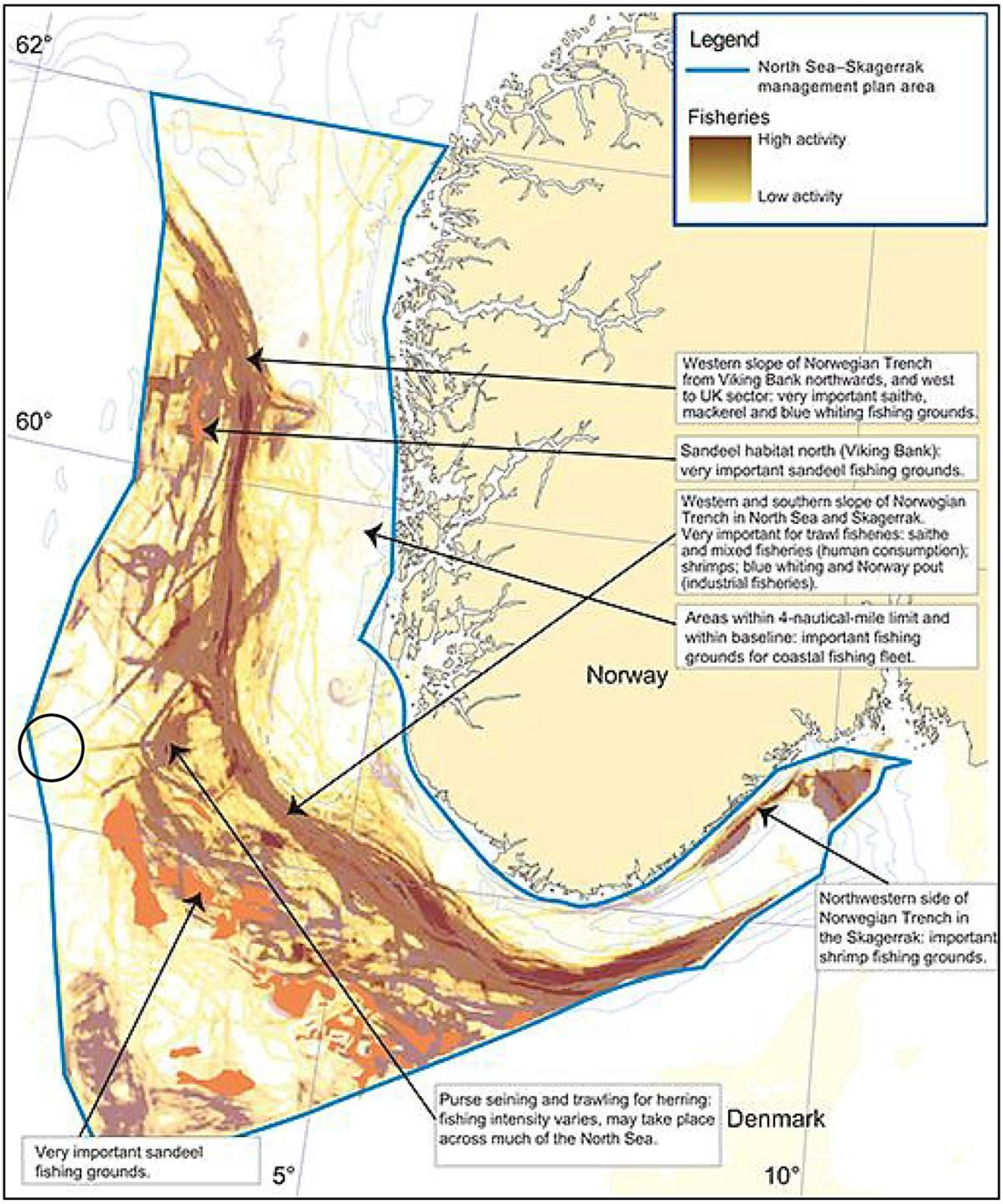

Figure 3.13 Fishing activity in the Norwegian North Sea area (NME, 2013).

3.3.2 Oil and gas infrastructure

The Statfjord B platform is located within an area of major oil and gas development and infrastructure in the UKCS and NCS (Figure 3.14). Major UKCS field developments within 40 km to the Barnacle Field (distances to nearest field boundary), are listed in Table 3.7. Major surface infrastructure in the Norwegian sector are provided in Table 3.8.

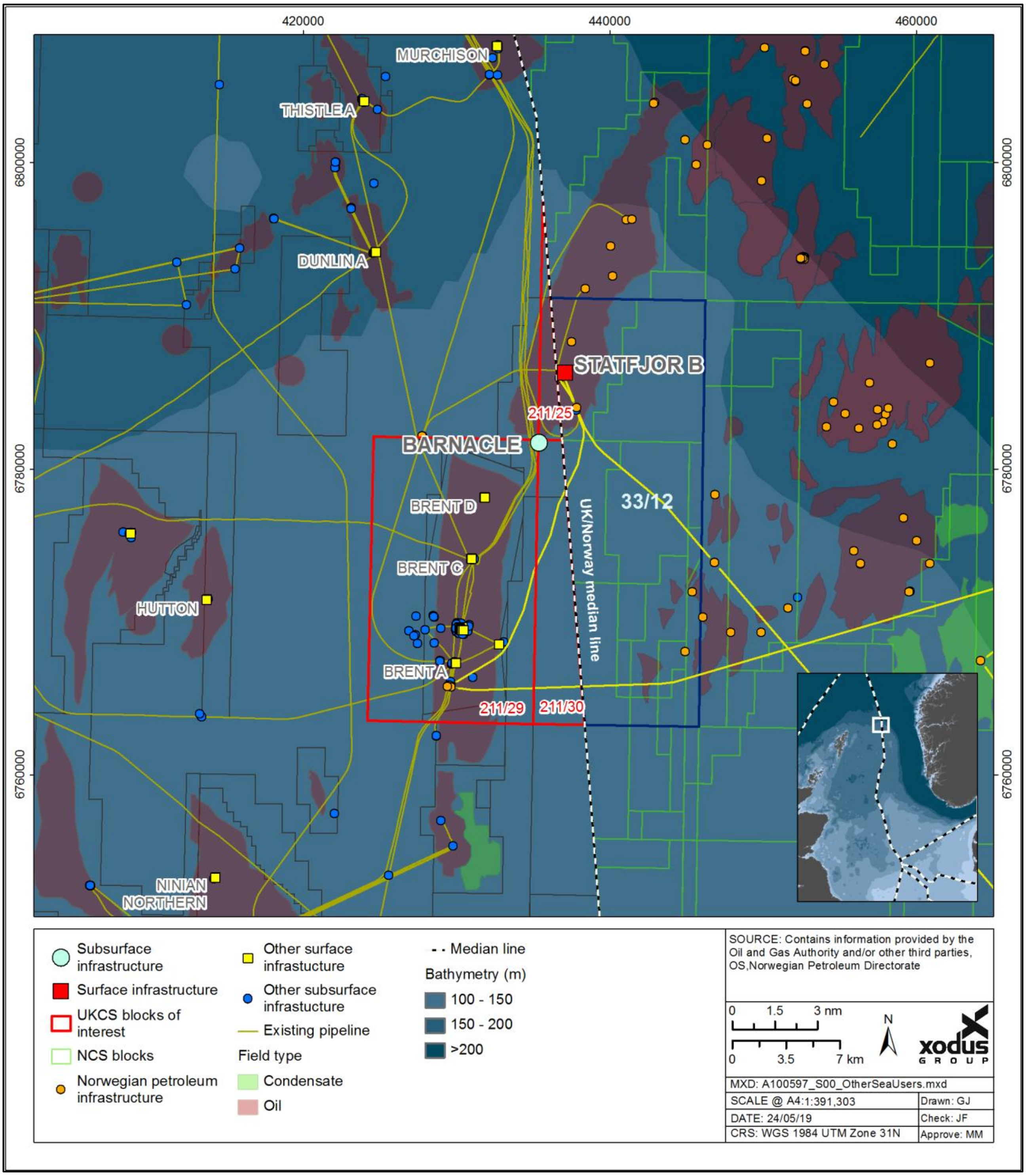

Figure 3.14 Other infrastructure in the vicinity of the Barnacle well and Statfjord B platform.

Table 3.7 Surface infrastructure in the UKCS within 40 km of the Barnacle Field.

NAME	STATUS	OPERATOR	DISTANCE (KM)	BEARING (degrees)	DIRECTION
STATFJORD B	ACTIVE	EQUINOR	4.95	20	NNE
BRENT D	ABANDONED	SHELL	5.03	225	SSW
BRENT C	ACTIVE	SHELL	8.76	210	SSW
BRENT B	ACTIVE	SHELL	13.04	202	SSW
BRENT FLARE	REMOVED	SHELL	13.44	191	SSW
BRENT A	ACTIVE	SHELL	15.37	201	SSW
DUNLIN A	ACTIVE	FAIRFIELD	16.40	319	NNW
HUTTON	REMOVED	MAERSK	23.98	245	WSW
THISTLE A	ACTIVE	ENQUEST	25.05	333	NNW
MURCHISON	ABANDONED	CNR	26.04	354	NNW
NW HUTTON A	REMOVED	BP	27.26	257	WSW
NINIAN NORTHERN	ACTIVE	CNR	35.38	217	SSW
ALWYN 3/2004-15S	REMOVED	TOTAL	35.98	191	SSW
CORMORANT NORTH	ACTIVE	TAQA	35.99	285	WNW
NINIAN CENTRAL	ACTIVE	CNR	38.73	209	SSW
ALWYN NORTH NAB	ACTIVE	TOTAL	39.68	186	SSW
ALWYN NORTH NAA	ACTIVE	TOTAL	39.77	186	SSW
CORMORANT A	ACTIVE	TAQA	39.82	261	WSW

Table 3.8 Surface infrastructure in the NCS within 40 km of the Barnacle Field

NAME	TYPE	STRUCTURE/ FIELD	DISTANCE (KM)	BEARING (degrees)	DIRECTION
STATFJORD B	CONDEEP 4 SHAFTS	STATFJORD	4.95	20	NNE
STATFJORD-B-SPM	LOADING SYSTEM	STATFJORD	4.95	20	NNE
STATFJORD B-OLS	LOADING SYSTEM	STATFJORD	6.93	18	NNE
STATFJORD A	CONDEEP 3 SHAFTS	STATFJORD	10.51	17	NNE
STATFJORD-A-ALP	LOADING SYSTEM	STATFJORD	11.92	24	NNE
STATFJORD A-OLS	LOADING SYSTEM	STATFJORD	11.93	24	NNE
STATFJORD C-SPM	LOADING SYSTEM	STATFJORD	13.69	20	NNE
STATFJORD C	CONDEEP 4 SHAFTS	STATFJORD	15.65	21	NNE
GULLFAKS A-SPM 1	LOADING SYSTEM	GULLFAKS	19.43	82	ENE
GULLFAKS A	CONDEEP 4 SHAFTS	GULLFAKS	20.93	87	ENE
GULLFAKS B	CONDEEP 4 SHAFTS	GULLFAKS	21.95	80	ENE
GULLFAKS A-SPM 2	LOADING SYSTEM	GULLFAKS	23.08	90	ESE
GULLFAKS C	CONDEEP 4 SHAFTS	GULLFAKS	26.04	78	ENE
VALEMON	JACKET 4 LEGS	VALEMON	32.15	116	ESE
SNORRE A	TLP STEEL	SNORRE	36.64	31	NNE
KVITEBJÃƒ ËœRN	JACKET 4 LEGS	KVITEBJÃƒËœRN	38.82	105	ESE

3.3.3 Shipping

Shipping density is low in Blocks 211/29 and 211/30 (DECC, 2018). The shipping traffic around the Statfjord Field has historically been relatively low, with about 500 to 750 annual passes within a radius of 10 nautical miles, corresponding to one to two passes per day on average. There are ten main ship routes within this radius, with about 700 passes a year, corresponding to about 14 vessels per week (Figure 3.15). Within a radius of 3 nautical miles (nm) there are about 26 passages a year (Equinor, 2018b).

The main part of shipping traffic in the area consists of offshore vessels supporting nearby oil and gas installations. The traffic within the 10 nm zone includes supply vessels and the remaining includes tankers. The density of fishing vessels is also low and most fishing vessels keep a good distance from the installations in the field.

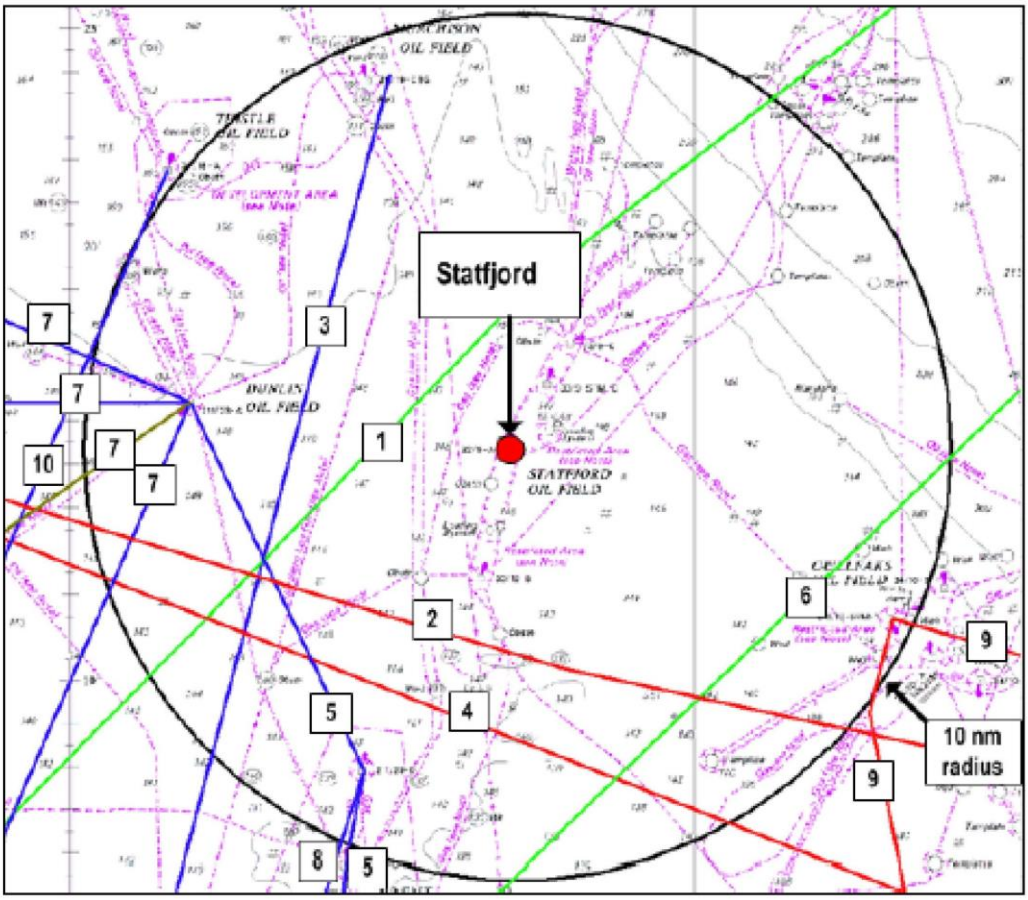

Figure 3.15 Plot of the main routes within 10 nm of Statfjord Field (Equinor, 2018b)

3.4 Defence

No routine military activities are known to occur in the vicinity of the Barnacle or Statfjord Fields.

3.5 Telecommunications

There are no known submarine telecommunications cables in the vicinity of the Statfjord B platform.

3.6 Summary of key environmental sensitivities in the Barnacle Field area

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Habitats Directive: Annex I Habitats There are no known Annex I habitats in the Barnacle Field Development area.											
Habitats Directive: Annex II Species Of the four Annex II species, only the harbour porpoise has been sighted in the area, with low abundance in January to March, moderate to high abundance from April to September and in December (UKDMAP, 1998).											
Benthic Fauna Benthic communities in the Barnacle Field area are similar to those found throughout a large surrounding area of the NNS. There were large variations in the number of individuals per station, taxa, and diversity over the Statfjord Field.											
Plankton The plankton in the Barnacle Field area is typical of the NNS. Peak productivity occurs in spring and summer.											
Finfish and Shellfish The Barnacle Field Development area is located in spawning grounds for cod (Jan to April), haddock (Feb to May), Norway pout (Jan to April), saithe (Jan to April) and whiting (Feb to June), and within nursery grounds for anglerfish, blue whiting, European hake, haddock, herring, ling, mackerel, Norway pout, plaice and spur dog (throughout the year) (Coull *et al*., 1998; Ellis *et al*., 2010).											
Marine Mammals The main marine mammal species occurring in the Barnacle Field Development area are harbour porpoise, killer whale, minke whale, sperm whale, pilot whale, white beaked dolphin and white-sided dolphin. The majority of sightings have taken place during the spring and summer period (Reid *et al*., 2003; UKDMAP, 1998).											
Seabirds Seabird sensitivity to oil pollution in the Barnacle Field and Statfjord B platform area is “low to medium” from January to October and “high” in November and December. The overall vulnerability in the Barnacle Field Development area is “low” (JNCC, 1999).											
Fisheries The Barnacle Field Development area is of “Very High” to “High” relative value for fishing. Fishing effort is “High” to “Low” and dominated by demersal and pelagic gear types. (Marine Scotland, 2013).											
Shipping Shipping density in the Barnacle Field Development area ranges from low to very low density (DECC, 2104; Equinor, 2018b).											

KEY:
- Very High sensitivity/ value
- High sensitivity/ value
- Moderate sensitivity/ value
- Low sensitivity/ value

4 EIA METHODOLOGY

Offshore activities can involve a number of environmental interactions and impacts due to, for example, operational emissions and discharges and general disturbance. The objective of the EIA process is to incorporate environmental considerations into project planning, to ensure that best environmental practice is followed and, ultimately, to achieve a high standard of environmental performance and protection. The process also allows for any potential concerns identified by stakeholders to be addressed appropriately. In addition, it ensures that the planned activities are compliant with legislative requirements and Equinor's HSE policy.

4.1 Environmental issues identification

The main objective for identifying environmental issues is to focus on those key potential environmental impacts requiring discussion and assessment, and to agree practicable measures (mitigation) to eliminate or minimise harm to the environment.

In this project, the nature and scale of the potential environmental issues are well understood, as drilling of a well from the Statfjord B platform and subsequent production of oil via the platform are regulated by the Norwegian authorities and have been assessed for a number of existing wells. The procedures and risks associated with drilling of and production from a well at this location, and from this structure, are well understood and mitigation and environmental management procedures exist to reduce the risk to the environment.

For this project, however, the potential impact sources and issues were reviewed. This is summarised below and described in more detail in Section 4.6, and with consideration given to whether additional or new risk may occur from the proposed development plan.

- Discharges to sea;
- Seabed disturbance;
- Underwater noise;
- Interaction with other sea users;
- Waste generation;
- Atmospheric emissions; and,
- Accidental events.

4.2 Scoping and consultation

No formal scoping was undertaken due to the limited nature and scope of activities described in this ES. The scoping conducted involved email correspondence with OPRED on 3/4/2019, 26/4/2019 and 29/4/2019 to confirm the overall scope given the lack of any new infrastructure required on the UKCS. Stakeholder sensitivities and concerns on the NNS are well understood and it is expected that any additional concerns will be raised during the public and regulatory consultation period.

4.3 Human health

Human health impacts from routine and accidental events were considered during the EIA and were determined to require no further assessment within the EIA process, especially since activities are far offshore and will be managed to meet industry and Equinor's requirements for safe operations.

4.4 Environmental significance

The EIA Regulations require that the EIA should consider the likely potentially significant impacts of a project on the environment. The decision process related to defining whether or not a project is likely to significantly impact the environment is the core principle of the EIA process. The EIA Regulations do not provide a specific definition of significance, however, methods used for identifying and assessing potential impacts should be transparent and verifiable.

The method used in this EIA and presented here has been developed by reference to:

- Institute of Ecology and Environmental Management (IEEM) guidelines for marine impact assessment (IEEM, 2010);
- Marine Life Information Network (MarLIN) species and ecosystem sensitivities guidelines (Tyler-Walters *et al*., 2001);
- Guidance provided by Scottish Natural Heritage (SNH) in their handbook on EIA (SNH, 2018);
- The Institute of Environmental Management and Assessment (IEMA) in their *Guidelines for EIA* (IEMA, 2016); and
- OPRED's updated (rev 5, February 2019) EIA Guidance, *The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) – A Guide* (BEIS, 2019).

The EIA provides an assessment of the environmental effects that may result from a project's impact on the receiving environment. The terms impact and effect have specific definitions in the EIA process with one driving the other — impacts are defined as the changes resulting from an action, and effects are defined as the consequences of those impacts.

In general, impacts are specific, measurable changes in the receiving environment (volume, time and/or area). Effects (the consequences of those impacts) consider the response of a receptor to an impact. The relationship between impacts and effects is not always straightforward. For example, a secondary effect may result in both a direct and indirect impact on a single receptor. There may also be circumstances where a receptor is not sensitive to a particular impact and thus there will be no significant effect or consequence.

For each impact, the assessment identifies a receptor's sensitivity and vulnerability to that effect and implements a systematic approach to understand the level of impact. The process considers the following:

- Identification of receptor and impact (including duration, timing and nature of impact);
- Definition of sensitivity, vulnerability and value of receptor;
- Definition of magnitude and likelihood of impact; and,
- Assessment of the consequence of the impact on the receptor, considering the probability that it will occur, the spatial and temporal extent, and the importance of the impact. If the assessment of consequence of impact is determined as moderate or major, it is considered a significant impact.

Once the consequence of a potential impact has been assessed it is possible to identify measures that can be taken to mitigate impacts through design or engineering decisions, or execution of the project. This process also identifies aspects of the project that may require monitoring, such as a post-decommissioning survey at the completion of the works to inform inspection reports.

For some impacts, significance criteria are standards or are numerically based. For others, for which there are no applicable limits, standards or guideline values, a more qualitative approach is required. This involves assessing significance using professional judgement.

Despite the assessment of impact significance being a subjective process, a defined methodology has been used to make the assessment as objective as possible and consistent across different topics. The assessment process is summarised below. The terms and criteria associated with the impact assessment process are described and defined; details on how these are combined to assess consequence and impact significance are then provided.

4.4.1 Environmental characterisation

To assess potential impacts on the environment, characterisation is required of the different aspects of the baseline or receiving environment that could potentially be affected. The environment in and around the project has been described in Chapter 3, using desk studies and site-specific surveys. Information obtained from key stakeholders also helped characterise specific aspects of the environment.

Where data gaps and uncertainties remained (i.e., no suitable options to filling data gaps), these have been documented and taken into consideration as part of the assessment of impact significance in each impact assessment section. The EIA process requires identification of the potential receptors that could be affected by the project (e.g., seabirds, marine mammals, seabed species and habitats). High-level receptors are identified within the impact assessment sections in Chapter 5.

4.4.2 Impact definition

The following sections describe the key potential characteristics of an impact.

4.4.2.1 Impact magnitude

Determination of impact magnitude requires consideration of a range of key impact criteria including:

- Nature of the impact, whether it be beneficial or adverse (Table 4.1);
- Type of impact, be it direct or indirect etc., (Table 4.2);
- Duration over which the impact is likely to occur, e.g., days, weeks (Table 4.3);
- Size and scale of impact, e.g., the geographic area (Table 4.4);
- Project phase when impact is likely to occur (e.g., pre-construction, installation and construction, commissioning);
- Seasonality of the impact, i.e., is the impact expected to occur all year or during specific times of the year; and,
- Frequency of impact, i.e., how often the impact is expected to occur (Table 4.5).

Each of these variables is expanded upon in tables below to provide consistent definitions across all EIA topics. In each impact assessment section, these terms are used in the assessment summary table and are described as necessary in any supporting text. With respect to the nature of the impact (Table 4.2), it should be noted that all impacts discussed in this ES are adverse unless explicitly stated otherwise.

Table 4.1 Nature of impact

Nature of impact	Definition
Beneficial	Advantageous or positive effect to a receptor (i.e., an improvement).
Adverse	Detrimental or negative effect to a receptor.

Table 4.2 Type of impact

Impact Type	Definition
Direct	Impacts that result from a direct interaction between the project and the receptor. Impacts that are actually caused by the introduction of project activities into the receiving environment. For example, the direct loss of benthic habitat.

Impact Type	Definition
Indirect	Reasonably foreseeable impacts that are caused by the project but which occur later in time than the original/start, or occur at a further distance from the proposed project area. Indirect impacts include impacts that may be referred to as *secondary*, *related* or *induced*. For example, the direct loss of benthic habitat could have an indirect or secondary impact on by-catch of non-target species due to displacement of these species caused by loss of habitat.
Cumulative	Impacts that act together with other impacts (including those from any concurrent or planned future third-party activities) to affect the same receptors as the proposed project. Definition encompasses "in-combination" impacts.

Table 4.3 Duration of impact

Duration	Definition
Temporary	Impacts that are predicted to be of short duration (e.g., less than one year) and are temporary or intermittent in nature.
Short-term	Impacts that are predicted to last for a limited period of time (e.g., between 1 and 5 years) and will cease on completion of the project activities (e.g., installation/construction) or as a result of planned mitigation, reinstatement or natural recovery.
Medium-term	Impacts that are predicted to last more than a few years (e.g., between 5 and 10 years, depending on overall project lifetime). For example, impacts that might occur during construction and installation (e.g., over a couple of years) but may last longer than this until mitigation, reinstatement or natural recovery has taken effect.
Long-term	Impacts that may, but not necessarily, commence during construction/installation and are expected to continue for the duration of the project, or in some cases beyond the lifetime of the project, before eventually ceasing. These include ongoing intermittent or repeated activities e.g., maintenance or seasonal events that are required to take place for the lifetime of the project.
Permanent	Impacts that are predicted to cause a permanent irreversible change and to continue well beyond the planned lifetime of the project.

Table 4.4 Geographic extent of impact

Geographic extent	Description
Local	Impacts that are limited to the area surrounding the proposed project footprint and associated working areas. Alternatively, where appropriate, impacts that are restricted to a single habitat or biotope or administrative area or local community.
Regional	Impacts that are experienced beyond the local area to the wider region, as determined by habitat/ecosystem extent or by administrative area boundaries.
National	Impacts that affect nationally important receptors or protected areas, or which have consequences at a national level. This extent may refer to either Scotland or the UK depending on the context.
Transboundary	Impacts that could be experienced by neighbouring national administrative areas.
International	Impacts that affect areas protected by international conventions, European and internationally designated areas or internationally important populations of key receptors (e.g., birds, marine mammals).

Table 4.5 Frequency extent of impact

Frequency	Description
Continuous	Impacts that occur continuously or frequently.
Intermittent	Impacts that are occasional or occur only under a specific set of circumstances that occurs several times during the course of the project. This definition also covers such impacts that occur on a planned or unplanned basis and those that may be described as "periodic" impacts.

4.4.2.2 Impact magnitude criteria

Overall impact magnitude requires consideration of all impact parameters described above. Based on these parameters, magnitude can be assigned following the criteria outlined in Table 4.6. The resulting effect on the receptor is considered under vulnerability and is an evaluation based on scientific judgement.

Table 4.6 Impact magnitude criteria

Magnitude	Criteria
Major	Extent of change: Impact occurs over a large scale or spatial geographic extent and /or is long term or permanent in nature. Frequency/ intensity of impact: high frequency (occurring repeatedly or continuously for a long period of time) and/or at high intensity.
Moderate	Extent of change: Impact occurs over a local to medium scale/ spatial extent and/or has a short to medium-term duration. Frequency/intensity of impact: medium to high frequency (occurring repeatedly or continuously for a moderate length of time) and/or at moderate intensity or occurring occasionally/intermittently for short periods of time but at a moderate to high intensity.
Minor	Extent of change: Impact occurs on-site or is localised in scale/ spatial extent and is of a temporary or short-term duration. Frequency/intensity of impact: low frequency (occurring occasionally/intermittently for short periods of time) and/or at low intensity.
Negligible	Extent of change: Impact is highly localised and very short-term in nature (e.g. days/ few weeks only).
Positive	An enhancement of some ecosystem or population parameter.
Notes: Magnitude of an impact is based on a variety of parameters. Definitions provided above are for guidance only and may not be appropriate for all impacts. For example, an impact may occur in a very localised area (minor to moderate) but at very high frequency/ intensity for a long period of time (major). In such cases expert judgement is used to determine the most appropriate magnitude ranking and this is explained through the narrative of the assessment.	

4.4.2.3 Impact likelihood for unplanned and accidental events

The likelihood of an impact occurring for unplanned/ accidental events is another factor that is considered in this impact assessment. This captures the probability that the impact will occur and also the probability that the receptor will be present.

4.4.3 Receptor definition

As part of the assessment of impact significance it is necessary to differentiate between receptor sensitivity, vulnerability and value. The sensitivity of a receptor is defined as "the degree to which a receptor is affected by an impact" and is a generic assessment based on factual information whereas an assessment of vulnerability, which is defined as "the degree to which a receptor can or cannot cope with an adverse impact" is based on professional judgement taking into account a number of factors, including the previously assigned receptor sensitivity and impact magnitude, as well as other factors such as known population status or condition, distribution and abundance.

4.4.3.1 Receptor sensitivity

Example definitions for assessing the sensitivity of a receptor are provided in Table 4.7.

Table 4.7 Sensitivity of receptor

Receptor sensitivity	Definition
Very high	Receptor with no capacity to accommodate a particular effect and no ability to recover or adapt.
High	Receptor with very low capacity to accommodate a particular effect with low ability to recover or adapt.
Medium	Receptor with low capacity to accommodate a particular effect with low ability to recover or adapt.
Low	Receptor has some tolerance to accommodate a particular effect or will be able to recover or adapt.
Negligible	Receptor is generally tolerant and can accommodate a particular effect without the need to recover or adapt.

4.4.3.2 Receptor vulnerability

Information on both receptor sensitivity and impact magnitude is required to be able to determine receptor vulnerability. These criteria, described in Tables 4.6 and 4.7, are used to define receptor vulnerability as given in Table 4.8.

Table 4.8 Vulnerability of receptor

Receptor vulnerability	Definition
Very high	The impact will have a permanent effect on the behaviour or condition of a receptor such that the character, composition or attributes of the baseline, receptor population or functioning of a system will be permanently changed.
High	The impact will have a prolonged or extensive temporary effect on the behaviour or condition of a receptor resulting in long term or prolonged alteration in the character, composition or attributes of the baseline, receptor population or functioning of a system.
Medium	The impact will have a temporary effect on the behaviour or condition of a receptor such that the character, composition, or attributes of the baseline, receptor population or functioning of a system will either be partially changed post Project or experience extensive temporary change.
Low	Impact is not likely to affect long term function of system or status of population. There will be no noticeable long-term effects above the level of natural variation experience in the area.
Negligible	Changes to baseline conditions, receptor population of functioning of a system will be imperceptible.

It is important to note that the above approach to assessing sensitivity / vulnerability is not appropriate in all circumstances and in some instances professional judgement has been used in determining sensitivity. In some cases, it has also been necessary to take a precautionary approach where stakeholder concern exists with regard to a particular receptor. Where this is the case, it is detailed in the relevant impact assessment section in Chapter 5.

4.4.3.3 Receptor value

The value or importance of a receptor depends on a pre-defined judgement based on legislative requirements, guidance or policy. Where these may be absent, it is necessary to make an expert judgement on receptor value based on the perceived views of key stakeholders, experts and specialists. Examples of receptor value definitions are provided in Table 4.9.

Table 4.9 Value of receptor

Value of receptor	Receptor type	Definition (example only – does not cover all receptors)
Very high	Environmental receptors	A receptor of very high importance or rarity. For example, pecies that are globally threatened such as the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species including those listed as endangered or critically endangered and/or a significant proportion of the international population (> 1%) is found within the project site.
	Cultural and socio-economic receptors	Receptor has no alternative to use an alternative area. Receptor is entirely dependent on the project area for all income / activities. Receptor is the best known / only example to contribute to knowledge and understanding and / or outreach.
High	Environmental receptors	Receptor of high importance or rarity, such as species listed as near-threatened or vulnerable on the IUCN Red List. Habitats and species protected under the EU Habitats Directive. Bird species protected under the EU Birds Directive. Habitats and species (including birds) that are a qualifying interest of a SAC, SPA or Ramsar site and a significant proportion of the national population (>1%) is found within the project site. Conservation interests (habitats and species) of MPAs, Heritage MPAs and MCZs.
High	Cultural and socio-economic receptors	Receptors and sites of international cultural importance, such as United Nations Educational, Scientific and Cultural Organisation (UNESCO) World Heritage Sites (WHSs). Receptor has little flexibility to use an alternative area. Receptor generates the majority of income from the project area. Receptor is above average example and/or has high potential to contribute to knowledge and understanding and/or outreach.
Medium	Environmental receptors	Receptor of least concern on the IUCN Red List, listed as a breeding species on Schedule 1 of the Wildlife and Countryside Act 1981, form a cited interest of a Site of Special Scientific Interest (SSSI), are listed in the UK Biodiversity Action Plan or on the Birds of Conservation Concern (BOCC) Red List and a significant proportion of the regional population (>1%) is found within the project site.
	Cultural and socio-economic receptors	Receptor has some flexibility to use an alternative area. Receptor is active in the project area and uses it for up to half of its annual income/activities. Receptor is average example and/or has moderate potential to contribute to knowledge and understanding and/or outreach.
Low	Environmental receptors	Any other species of conservation interest, such as BOCC Amber listed species.
	Cultural and socio-economic receptors	Receptor has high flexibility to use an alternative area. Receptor is active in the project area and other areas and is reliant on project area for some income/activities.

Value of receptor	Receptor type	Definition (example only – does not cover all receptors)
		Receptor is below average example and/or has low potential to contribute to knowledge and understanding and / or outreach.
Negligible	Environmental receptors	Receptor of very low importance, such as those which are generally abundant around the UK and Ireland with no specific value or conservation concern.
	Cultural and socio-economic receptors	Receptor is very active in other areas and not typically present in the project area. Receptor does not generate any income/activities from the project area. Receptor is poor example and/or has no potential to contribute to knowledge and understanding and/or outreach.

4.4.4 Consequence and significance of potential impact

Having determined impact magnitude and the sensitivity, vulnerability and value of the receptor, it is then necessary to evaluate impact significance. This involves:

- Determination of impact consequence based on a consideration of sensitivity, vulnerability and value of the receptor and impact magnitude;
- Assessment of impact significance (in accordance with EIA regulations) based on assessment consequence;
- Mitigation; and,
- Residual impacts.

4.4.4.1 Assessment of consequence and impact significance

The sensitivity, vulnerability and value of receptors are combined with magnitude (and likelihood, where appropriate) of impact using expert judgement to arrive at a consequence for each impact, as shown in Table 4.10. The significance of impact is derived directly from the assigned consequence ranking.

Table 4.10 Assessment of consequences

Assessment consequence	Description (consideration of receptor sensitivity and value and impact magnitude)	Impact significance (EIA regulations)
Major consequence	Impacts are likely to be highly noticeable and have long-term effects, or permanently alter the character of the baseline and are likely to disrupt the function and status/value of the receptor population. They may have broader systemic consequences (e.g., to the wider ecosystem or industry). These impacts are a priority for mitigation in order to avoid or reduce the anticipated effects of the impact.	Significant
Moderate consequence	Impacts are likely to be noticeable and result in lasting changes to the character of the baseline and may cause hardship to, or degradation of, the receptor population, although the overall function and value of the baseline/receptor population is not disrupted. Such impacts are a priority for mitigation in order to avoid or reduce the anticipated effects of the impact.	Significant
Low consequence	Impacts are expected to comprise noticeable changes to baseline conditions, beyond natural variation, but are not expected to cause long-term degradation, hardship, or impair the function and value of the receptor. However, such impacts may be of interest to stakeholders and/or represent a contentious issue during the decision-making process and should therefore be avoided or mitigated as far as reasonably practicable.	Not significant

Assessment consequence	Description (consideration of receptor sensitivity and value and impact magnitude)	Impact significance (EIA regulations)
Negligible	Impacts are expected to be either indistinguishable from the baseline or within the natural level of variation. These impacts do not require mitigation and are not anticipated to be a stakeholder concern and/or a potentially contentious issue in the decision-making process.	Not significant
Positive	Impacts are expected to have a positive benefit or enhancement. These impacts do not require mitigation and are not anticipated to be a stakeholder concern and/or a potentially contentious issue in the decision-making process.	Not significant

4.4.4.2 Mitigation

Where potentially significant impacts (i.e., those ranked as being of moderate impact level or higher in Table 4.10) are identified, mitigation measures must be considered. The intention is that such measures should remove, reduce or manage the impacts to a point where the resulting residual significance is at an acceptable or insignificant level. Mitigation is also proposed in some instances to ensure impacts that are predicted to be not significant remain so. Section 6.1 provides detail on these commitments and how any mitigation measures identified during the impact assessment will be managed.

4.4.4.3 Residual impacts

Residual impacts are those that remain once all options for removing, reducing or managing potentially significant impacts (i.e., all mitigation) have been taken into account.

4.5 Scoping of Issues

Scoping is a critical step in the preparation of an EIA. The scoping process identifies the issues that are likely to be of most importance and eliminates those that pose minimal risk or concern. In this way the EIA is focused on what may be significant effects.

4.5.1 Issues assessed

The consultation and technical review phases resulted in the following issues being considered and agreed for assessment in the EIA:

- Discharges to sea (Section 5.1)
    - Discharge of cementing and completion chemicals from drilling operations onto the seabed and into the water column, resulting in changes in water quality, localised and temporarily increased suspended solid concentrations, and possible impacts to organisms in the water column and on the seabed; and
    - Discharge of processed produced water into the water column resulting in changes in water quality and possible impacts on pelagic organisms.
- Seabed disturbance (Section 4.5.2)
    - Direct loss of benthic species;
    - Direct loss of existing seabed habitat; and
    - Wider indirect disturbance to the benthic environment through the suspension and re-settlement of cuttings, mud and cement discharges;

- Underwater noise (Section 4.5.2)
    - Injury and disturbance to marine mammals and fish through noise from drilling during the project.
- Interaction with other sea users and physical presence (Section 4.5.2)
    - Interference with shipping and fishing activities that may occur in the area;
    - Loss of access to the area for other vessels on a temporary or permanent basis; and
    - Increased risk of vessel collisions through the presence of the drill rig and other vessels during drilling activities.
- Atmospheric emissions (Section 5.2)
    - Climate change due to greenhouse gases (GHGs) including carbon dioxide (CO_2); and
    - Generation of acid rain from oxides of nitrogen (NOx) and sulphur (SO_x).
- Accidental events (Section 5.3)
    - Possible toxicity and smothering impacts to birds, other marine species (e.g., marine mammals) and habitats through the release of hydrocarbons and chemicals from a well blowout or loss of crude inventory from the Statfjord B platform.

4.5.2 Issues scoped out

During scoping and review the following potential environmental issues were identified but potential impacts were considered too small and likely to be insignificant. It was therefore agreed they would be scoped out of further assessment in the EIA:

- Discharges to sea
    - Routine blackwater production (sewage), grey water (from showers, laundry, hand and eye wash basins and drinking fountains), and food waste (macerated) disposal (from the platform) – these were scoped out due to existing, effective management controls in place for such discharges;
    - Ballast water – was scoped out as no major international movement of vessels expected for this project; and
    - Routine seawater usage for cooling (e.g., engine cooling) – was scoped out due to the highly limited temporal and spatial extent of such discharges.
- Seabed disturbance
    - Disturbance to benthic species and/or communities – neither cuttings nor OBM will be discharged to seabed and therefore no additional disturbance to the seabed is expected.
    - Barnacle well to be drilled from Statfjord B platform and therefore no disturbance to the seabed from a drilling rig or seabed anchors.
    - There will be no interaction or infrastructure in UKCS waters.
- Underwater noise
    - As fish use sound for various ecological processes, they may have the potential to be impacted by anthropogenic noise emissions through injury and disturbance mechanisms. However, evidence suggests such impacts are largely restricted to impulsive sounds (Popper and Hawkins, 2012; De Robertis and Handegard, 2012) and would be highly unlikely to occur on a scale which would have population-level consequences (Mood and Brooke, 2010). Similarly, should noise emissions disturb fish, the short-term movement away from the short-term activities would not constitute a large-scale movement by individuals of a species and

would be highly unlikely to result in population level impacts. On this basis, fish have been scoped out of further assessment.

  - Disturbance to marine mammals in the project area from additional vessels or collision between vessels and animals – scoped out as the drilling campaign will be from the platform and is a temporary short-term activity, and vessel use to support drilling activity will be minimal above existing levels for the Statfjord B platform.

- Interaction with other sea users and physical presence
  - Disturbance to ornithological features from vessels – scoped out since there will be no change in lighting compared to the baseline conditions on Statfjord B;
  - Disturbance to marine species in the project area from vessels or collision between vessels and animals – scoped out as the drilling campaign will be from the platform and is a temporary short-term activity, and thus vessel use to support drilling activity will be minimal; and
  - Impact on seascape – scoped out as there will be no change to the baseline surface infrastructure and the limited additional vessel presence will be sufficiently far offshore not to affect visual amenity.
  - Disturbance to fishing activities – scoped out since there will not be a drilling rig nor any new infrastructure will be placed within the project area.
  - Risk of collision to other users – scoped out since no additional support vessels are anticipated during the drilling of the Barnacle well.
- Waste
  - Routine generation and disposal of non-hazardous waste streams – scoped out due to existing, effective management controls in place for waste;
  - Routine generation and disposal of special/hazardous wastes, e.g. oily rags, medical waste, solvents, batteries, computers, fluorescent tubes, oil/grease/chemical cans/drums/sacks, – scoped out due to existing, effective management controls in place for waste; and
  - Routine generation and disposal of radioactive wastes (disposal onshore) (e.g., naturally occurring radioactive material (NORM), contaminated cuttings, radiation sources in safety/detection equipment) – scoped out as no radioactive waste is expected from the drilling campaign.
- Accidental events
  - Accidental deposit of materials on the seabed (e.g., dropped objects) – scoped out due to existing, effective management controls in place for dropped objects;
  - Limited unplanned operational releases, such as resulting from an overfill of the diesel tank bund – scoped out due to limited volumes and very low likelihood of occurrence; and
  - Natural disasters - it is considered that the implication of any natural disasters affecting the offshore region, such as an earthquake or extreme sea conditions (including tsunami), would most likely be the accidental event scenarios described in Section 5.30. The implication of release of chemicals and hydrocarbons from the project is assessed within Section 5.3, and natural disasters are therefore not discussed further.
- Recreation and tourism
  - Long-term restriction of access or amenity – scoped out due to absence of sensitive receptors in the area of potential impact.

4.6 Cumulative and in-combination impact assessment

The European Commission has defined cumulative impact as being those resulting "from incremental changes caused by other past, present or reasonably foreseeable actions together with the project" (European Commission, 1999). As outlined in studies by the European Commission (1999) and US CEQ (1997), identifying the cumulative impacts of a project involves:

- Considering the activities associated with the project;
- Identifying potentially sensitive receptors/resources;
- Identifying the geographic and time boundaries of the cumulative impact assessment;
- Identifying past, present and future actions which may also impact the sensitive receptors/resources;
- Identifying impacts arising from the proposed activities; and,
- Identifying which impacts on these resources are important from a cumulative impacts' perspective.

To assist the assessment of cumulative and in-combination impacts, a review of existing developments (including oil and gas, cables and renewables) that could have the potential to interact with the Barnacle well was undertaken. The output of the review is reported in the Environment Baseline (Chapter 3). The impact assessment has considered these projects when defining the potential for cumulative and in-combination impact (Chapter 5).

4.7 Transboundary impact assessment

Due to the location of the Statfjord B platform, where the Barnacle Field will be produced, on the NCS approximately 2.5 km from the UK/ Norway median line, there is a potential for transboundary impacts and these are considered in Section 5.

5 IMPACT ASSESSMENT

This section discusses the potential short- and long-term environmental impacts, scale of impacts, cumulative and transboundary impacts, and residual impacts associated with the environmental issues not scoped out in Section 4.

5.1 Discharges to sea

Drilling and operation of the Barnacle well will result in discharges to sea including cement during the drilling phase and discharges of produced water and production chemicals during the operational phase.

5.1.1 Impact mechanism

Cement discharges are expected to be restricted to the area immediately around the wellhead at the platform in an area that has already been developed and therefore expected to be not significant and cement discharges are not discussed further.

During the operational phase the principal disposal route for formation water produced from the Barnacle well and processed on the Statfjord B platform will be discharge to sea. Before disposal, water will be treated to the Norwegian regulatory oil-in-water standard of less than 30 mg/l. Chemicals injected into the wells or into the process fluids stream may partition into the water phase and therefore be discharged overboard.

5.1.2 Scale of impact

Produced water discharges from the Statfjord B process are not predicted to present a significant risk to the environment due to the dilution that will occur upon discharge and the lack of sensitive receptors in the area. The closest conservation site to the discharge point is over 100 km away, therefore no impacts on protected sites are expected.

5.1.3 Net change of produced water

The volume of produced water is decreasing with the decrease in overall production on the Statfjord B platform. Even with the inclusion of the produced water from the Barnacle well, the produced water discharge from the platform when the well begins producing will be at least 20% less than the average discharge for the last four years (Section 2.9.2). There is considered to be no potential for significantly increased risk to the environment due to Barnacle well discharge.

5.1.4 Cumulative and transboundary impacts

Water column cumulative impacts from produced water discharges are expected to be negligible and any small increase due to the proposed Barnacle development is not expected to change the expected impact magnitude. The nearest third-party infrastructure in the UKCS to the proposed drilling location is the Brent Field located approximately 10 km southwest from Statfjord B platform. Due to the low volume and distance to the nearest operating facility, there is no possibility of the Statfjord B discharges interacting with this or any other third-party development. As such, significant cumulative impacts are not expected.

The UK/ Norway median line is 2.5 km away. However, for reasons discussed above any transboundary impacts are not expected to be significant.

5.1.5 Residual impacts

Residual impacts are as given below in Table 5.1.

Table 5.1 Significance of residual impacts from discharges to sea

Receptor	Sensitivity	Vulnerability	Value	Magnitude	Consequence
Seabed	Low	Medium	Negligible	Negligible	Negligible
Water column	Low	Low	Negligible	Negligible	Negligible

5.2 Atmospheric emissions

Gaseous emissions from the project could result in impacts at a local, regional, transboundary and global scale.

5.2.1 Impact mechanism

Local, regional and transboundary issues include the potential generation of acid rain from nitrogen and sulphur oxides (NO_X and SO_X) released from combustion, and the human health impacts of ground level nitrogen dioxide (NO_2), sulphur dioxide (SO_2), both of which will be released from combustion, and ozone (O_3), generated via the action of sunlight on NO_x and volatile organic compounds (VOCs). On a global scale, concern with regard to atmospheric emissions is increasingly focused on global climate change. The Intergovernmental Panel on Climate Change (IPCC) in its fifth assessment report (IPCC, 2014) states that,

> "Anthropogenic GHG emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century."

Climate change projections included in the IPCC report predict a mean surface temperature change between 2016 and 2035 will likely be in the range of 0.3°C and 0.7°C (medium confidence). GHGs include water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous oxides (N_2O), O_3 and chlorofluorocarbons (IPCC, 2014).

Drilling and production operations can produce atmospheric emissions from combustion of fuel (fuel gas) to run facilities and equipment, and from flaring of produced gas either during well testing or during the production phase.

5.2.2 Scale of impact

Emissions from the Statfjord B platform are expected to decrease from 2019 through to CoP in 2026, even with the inclusion of the Barnacle well (Equinor, 2019b). The principal emissions from development of the Barnacle well will result from use of diesel, fuel gas and flaring. The predicted fuel gas and flaring and associated emissions for the period of 2019 to 2025 is provided in Table 5.2. Flaring is expected to be less than 10%, and will only be a result of process problems or for safety reasons. There will be no cold venting associated with the Barnacle product. Total CO_2 equivalent emissions from fuel gas and flaring on Statfjord B is represented in Figure 5.1. Norwegian emissions of greenhouse gases for 2017 from oil and gas extraction was 14.7 million tonnes CO_2 equivalent (Statistics Norway, 2019). The Barnacle Field Development will be a relatively minor contribution in the context of the Statfjord Field and equivalent emissions in the North Sea.

Table 5.2 Emissions from predicted use of fuel gas and flaring on Statfjord B.

Year	Fuel Gas and Flaring (tonnes)	Cumulative Fuel Gas and Flaring (tonnes)	Cumulative Emissions (tonnes)						
			CO_2	CO	NO_x	N_2O	SO_2	CH_4	VOC
2019	384	384	1,229.31	3.07	22.67	0.08	1.54	0.10	0.92
2020	5,186	5,570	17,825.02	28.97	69.63	1.23	22.28	0.48	4.46
2021	3,073	8,259	26,430.21	66.08	487.31	1.82	33.04	2.23	19.82
2022	1,345	9,604	30,732.80	76.83	566.64	2.11	38.42	2.59	23.05
2023	768	10,372	33,191.42	82.98	611.97	2.28	41.49	2.80	24.89
2024	384	10,756	34,420.74	86.05	634.63	2.37	43.03	2.90	25.82
2025	193	10,949	35,035.39	87.59	645.97	2.41	43.79	2.96	26.28

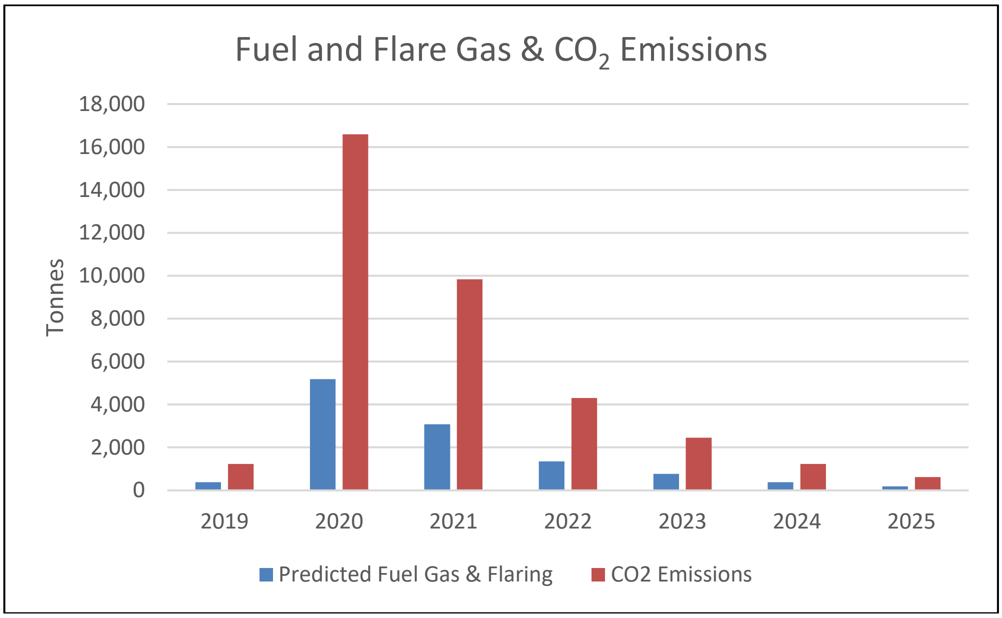

Figure 5.1 Predicted fuel gas usage and flaring during Barnacle Field life

5.2.3 Net change compared to current emissions at Statfjord B

The increased production will be within the existing processing capacity of Statfjord B and there will be no requirement for additional power generation. Associated fuel use on the platform will increase slightly during drilling. The inclusion of the produced oil and gas from the Barnacle well will slightly increase the overall oil production from the platform (see Section 2.9.1). Production from currently operating wells has been decreasing and the inclusion of the Barnacle oil and gas will supplement the total production from the platform. The oil produced on Statfjord B is in decline and will continue to decline, albeit at a slower rate with the inclusion of the Barnacle Field production.

5.2.4 Cumulative and transboundary impacts

Throughout the drilling and operation of the Barnacle Field Development there will be atmospheric emissions, which may have local or regional (including transboundary) effects. Any releases from vessels involved during the drilling campaign will be temporary, whilst emissions from operational activities will be intermittent throughout the life of the field.

5.2.4.1 Local air quality

While the Barnacle Field Development is in close proximity to other industrial activities (including other offshore oil and gas activity), the low levels of emissions expected, and the dispersive offshore climate prevailing within the area, suggest there will not be any likely cumulative effects in terms of local air quality. While atmospheric emissions from the Barnacle Field Development will cross into the UK this is not expected to result in significant transboundary impacts.

5.2.4.2 Global climate change

On a larger scale, emissions derived from the fossil fuel combustion at the Barnacle Field Development will contribute to cumulative worldwide environmental impacts such as global climate change. However, the direct impact is difficult to assess as these emissions will only form a very small part of the overall global air emissions. The estimated atmospheric emissions associated with the project are, therefore, only provided here to allow for general comparison to typical values for emissions for the UK and Norway exploration and production industry.

To understand the potential impact from the atmospheric emissions associated with the Barnacle Field Development, it is useful to set the emissions in the context of the wider UK and Norway emissions. The contribution of emissions from oil and gas industry emissions can provide a benchmark against which the Barnacle Field Development can be considered. The total annual CO_2 emissions estimate from oil and gas exploration and production is 13,100,000 T (for 2016, from Oil and Gas UK). The total CO_2 emissions from the Statfjord B platform for 2018 was reported as 296,720 T (Equinor, 2019c). For the Norwegian oil and gas industry the reported total CO_2 emissions for 2017 was 14,700,00 T (Statistics Norway, 2019b). Statfjord B accounts for approximately 2% of the overall annual offshore emissions for the UK and Norway from the oil and gas industry. The average CO_2 emissions from the Statfjord B platform is not expected to change during the production from the Barnacle Field. The estimated CO_2 emissions for the Statfjord B platform from 2019 through to 2025 is 290,017 T (Equinor, 2019c).

5.2.5 Residual impacts

Residual impacts are as given below in Table 5.3.

Table 5.3 Significance of residual impacts from atmospheric emissions

Receptor	Sensitivity	Vulnerability	Value	Magnitude	Consequence
Local air quality	Low	Low	Low	Minor	Low
Acid rain production	Low	Low	Low	Minor	Low
Global climate change	Low	Low	Low	Minor	Low

5.3 Accidental events

This section focuses on large scale hydrocarbon release as other types of accidental events have been scoped out in Section 4.5.2. A major hydrocarbon release is the most visible impact arising from oil and gas operations, and the impact that is most likely to have severe acute environmental impacts, especially on seabirds and coastal habitats and species. Seabirds are extremely vulnerable to hypothermia and drowning due to oiled plumage. There is considerable regulatory, stakeholder and public concern surrounding the possibility of a major release from any oil and gas installation and this is reflected in the stringent regulations which surround oil and gas operations, and the low and decreasing rate of incidents which occur.

Figure 5.2 shows the total mass of oil accidentally released each year on the UKCS from 1975 to 2017. It also shows the number of individual incidents that have occurred each year. From 1997 these incidents are broken down into those involving less than one tonne of oil and those involving one tonne or more. The annual number of releases of quantities ≥1 tonne of oil has decreased gradually since 1997 (Figure 5.2), however there were large single release events in 2010 (North Cormorant, 131 tonnes crude), 2011 (Gannet F, 218 tonnes crude), 2012 (Elgin, 405 tonnes gas condensate) and 2016 (Clair, estimated at 95 tonnes (BP, 2016)), which account for the majority of the elevated total tonnage of oil released in those years. Figure 5.2 illustrates that the vast majority of incidents involve <1 tonne of oil.

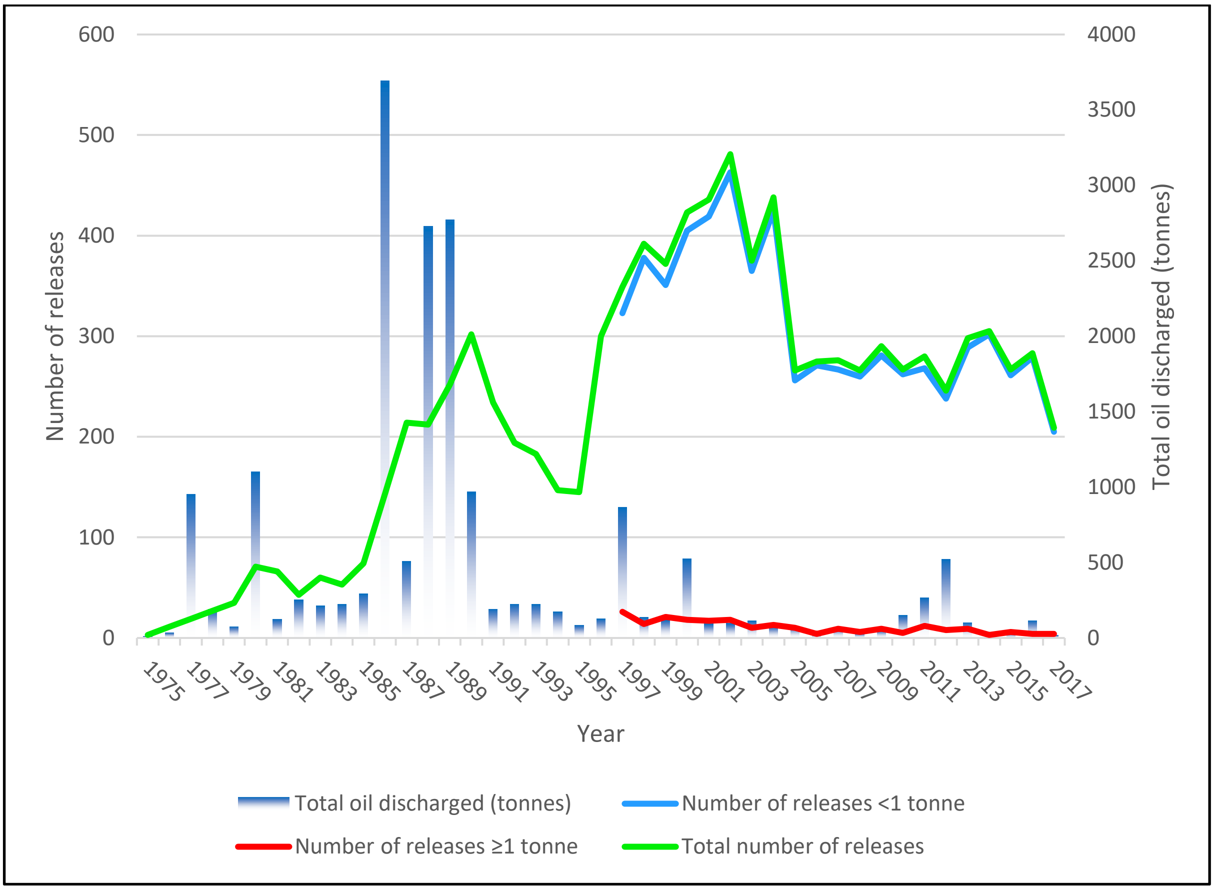

Figure 5.2 Total number of accidental hydrocarbon releases and amounts released (BEIS, 2019a; National Archives 2012a; National Archives 2012b; BP, 2016).

5.3.1 Impact mechanism

Seabirds are the receptor most at risk from spilled oil (JNCC, 2011). Due to their habits of sitting on and or diving through the sea surface, many species of seabirds are extremely vulnerable to oiling of plumage which can rapidly result in drowning or fatal hypothermia. Ingestion of oil during attempted preening of contaminated plumage can cause liver and kidney damage (Furness and Monaghan, 1987). Vulnerability varies between species; the Alcidae (auk) species are recognised as particularly at risk due to their frequent interactions with the sea surface.

Other offshore receptors are generally considered to have low vulnerability. In the case of plankton and fish this is due to widespread and numerous populations meaning population level impacts are unlikely. In the case of cetaceans there is conflicting evidence regarding individual vulnerability, but they are considered unlikely to suffer significant long-term impacts in the open sea (Aubin, 1990).

Coastal impacts vary widely depending on the type of oil released, the specific habitat (exposed coasts are considered less vulnerable than sheltered coasts) and the weather during the incident (rough weather can help to break up and disperse surface slicks into the water column, reducing the volume of oil that reaches shore).

5.3.2 Scale of impact

Modelling was conducted as part of Equinor's environmental risk assessment from a surface and subsurface release of oil at the Statfjord Field and platforms. Stochastic oil drift simulations were carried out with the Oil Spill Contingency and Response module (OSCAR), from SINTEF, for the following periods of the year: Winter/ Vinter (December-February), spring/ vår (March-May), summer/ sommer (June-August) and autumn/ høst

(September-November). A prolonged well blow out scenario with the release of 4,100 m^3 / day for a reservoir release from Statfjord A, B or C was modelled. The probability of beaching and area of influence from a release at the Statfjord Field is shown in Figures 5.3 and 5.4 for surface and seabed releases, respectively (Equinor, 2019b).

For the Statfjord Field, the largest quantities of oil beached and the shortest drift time (95 percentiles) is summarised in Table 5.4 below (Equinor, 2019b). In addition to the spill modelling, an environmental risk analysis for the potential effects on several pelagic (seabirds on open sea) and coastal seabird species, seals, fish and beach habitats were undertaken. The analysis was performed for the entire year. The total environmental risk level for the Statfjord Field is estimated to be highest for coastal seabirds with a risk of 35% of the field-specific acceptance criteria for serious environmental damage. The second highest environmental risk has pelagic seabirds with a risk of 32% of the field-specific acceptance criteria for a moderate environmental damage (Equinor, 2019b).

Table 5.4 **Model output of largest volume and shortest number of days for oil beaching in Norway.**

	Largest Stranded Volume (Tonnes)		Shortest Number of Days for Beaching	
	Summer	Winter	Summer	Winter
95-percentile	294	274	15	13

According to the Norwegian Pollution Control Act and its regulations, oil spill contingency related to oil production or exploration must be established based on the following three steps:

- An environmental risk analysis (ERA);
- A contingency analysis; and
- Development and implementation of a contingency plan.

Among the most important criteria related to ERA, environmental damage to selected indicators (e.g. bird populations) lasting more than 10 years shall not occur more frequent than 1 out of 40 000 drilling operations. National standards for ERA and contingency analysis based on a Net Environmental Benefit Analysis (NEBA) approach has been in use for several years in Norway (Nerland, 2012).

An emergency preparedness analysis for oil spill preparedness for Statfjord B was carried out by Equinor in 2015 and assessed in a note in 2019. Equinor will be responsible for any oil spill response. Equinor is a member of the Norwegian Clean Seas Association for Operating Companies (NOFO). NOFO provides operational support and emergency preparedness for oil release at sea, near the coast and at any beach sanctions. NOFO serves as a coordinating organisation if a spill occurs and is responsible for the tactical and operational management of recovery resources in use. In addition, Equinor is a subscriber to Oil Spill Response Limited (OSRL) and will be able to use oil spill resources from OSRL. OSRL is the largest international industry-funded cooperative which exists to respond to oil spills wherever in the world they may occur, by providing preparedness, response and intervention services.

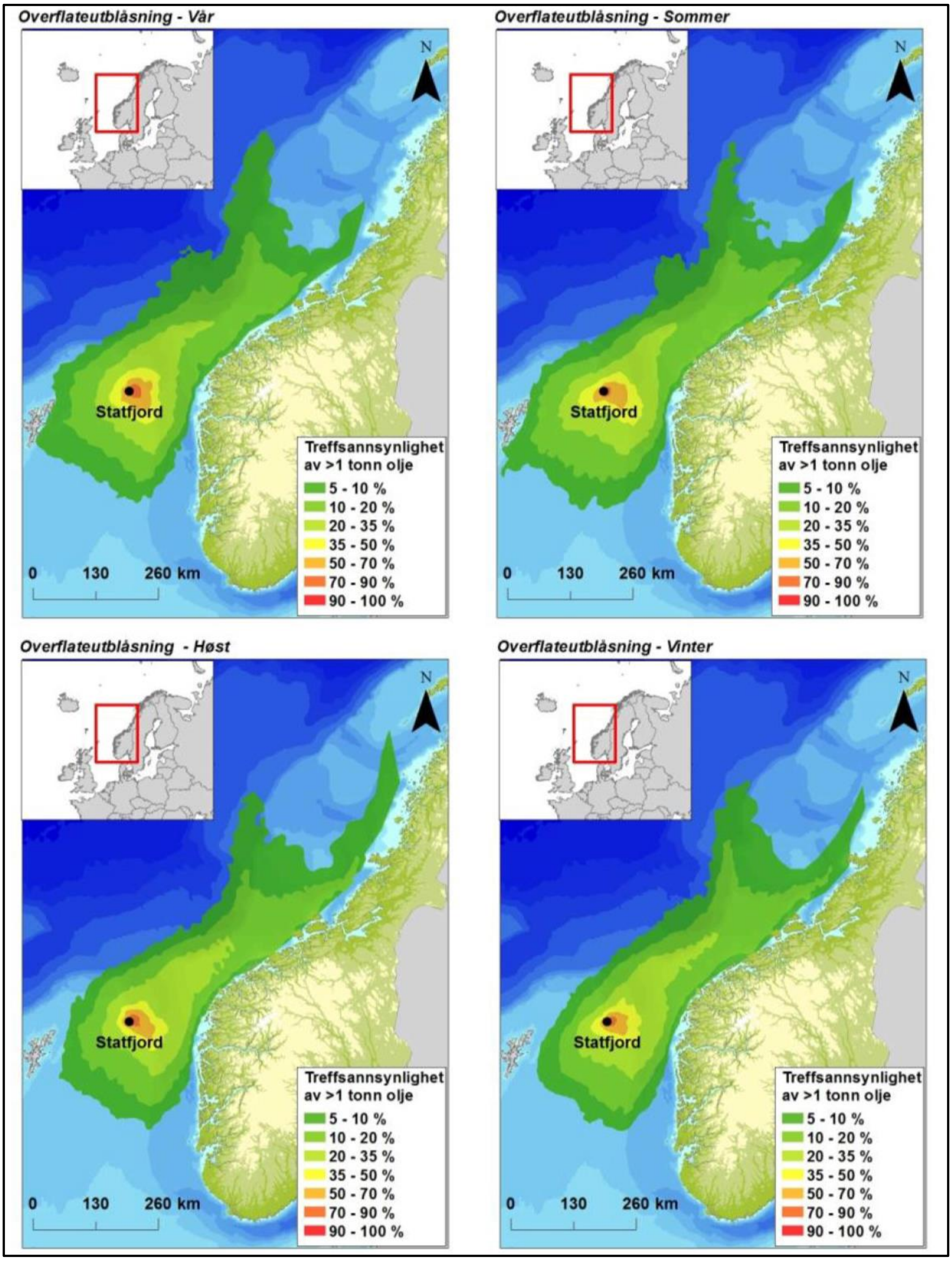

Figure 5.3 **Probability of the movement and beaching from a surface release of >1 tonne from the Statfjord Field in each season. The area of influence is based on release rates and durations and their individual probabilities. The highlighted area does not show the extent of a single oil release, but is the area affected in ≥ 5% of the individual simulations of the oil's movement and dispersion for each season.**

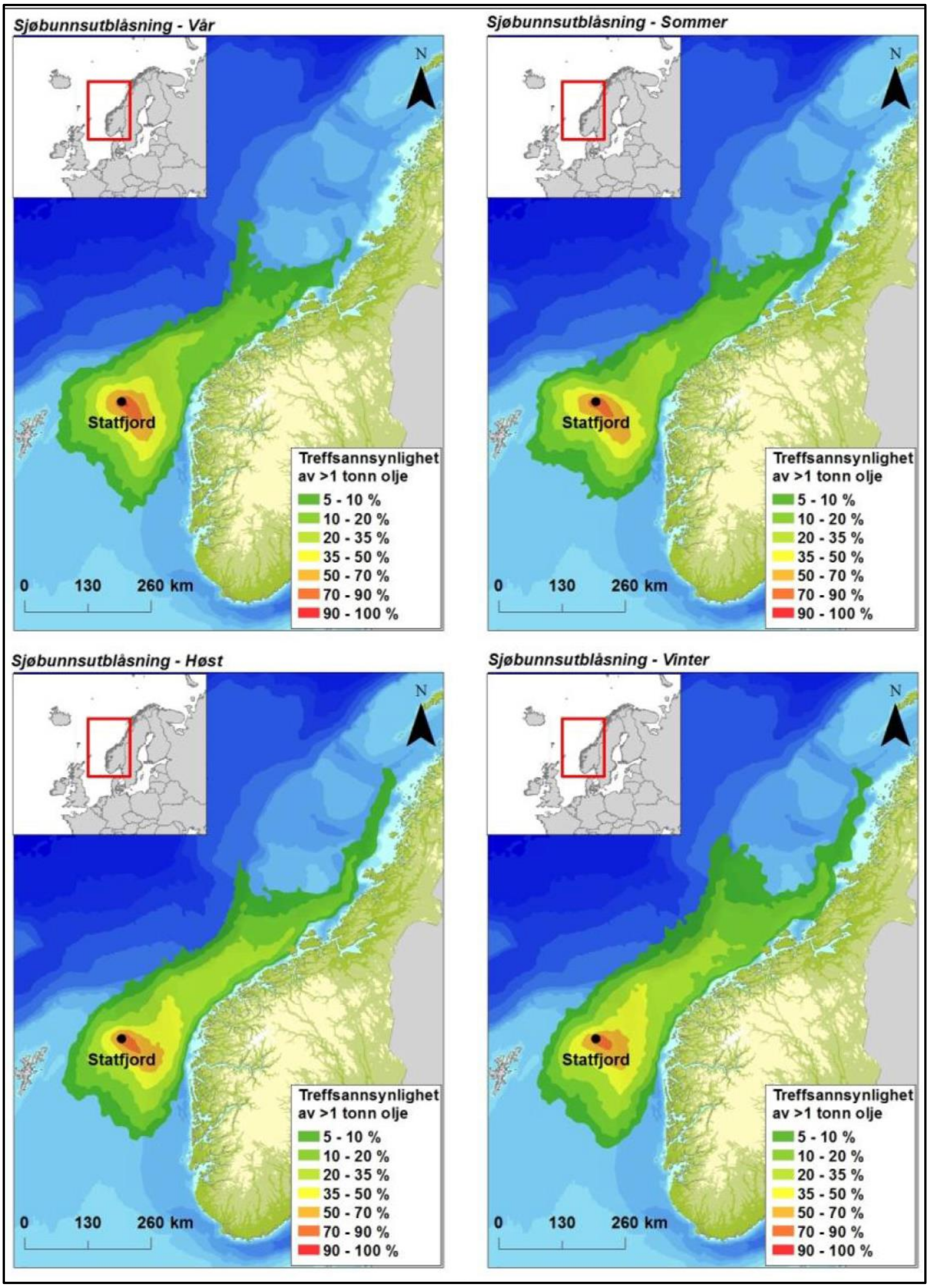

Figure 5.4 Probability of the subsurface movement and dispersal of >1 tonne of oil from a well blowout during drilling on the Statfjord Field in each season. The area of influence is based on release rates and durations and their individual probabilities. The highlighted area does not show the extent of a single oil blowout, but is the area affected in ≥ 5% of the individual simulations of the oil's movement and dispersion for each season.

5.3.3 Cumulative and transboundary impacts

Drilling of the Barnacle well will result in a slight increase in the risk of an accidental release occurring on the UKCS. Given the remote likelihood of an incident occurring however, this increase is not expected to be significant.

Worst-case well blowout scenario modelling indicated that spilled oil would cross the UK/ Norway median line, reaching the Shetland coast. An assessment of the potential impact to Shetland as a result of a well blowout from the Statfjord B platform indicated that beaching may occur in the spring or summer with the following characteristics:

- Less than a 5% probability for beaching on Shetland;
- Shortest arrival time to Shetland is 9 days;
- Maximum amount of oil beaching in Shetland is less than 150 g/m^2.

Conservation sites in and around Shetland that may be at risk include: Pobie Bank Reef SAC; Hascosay SAC; Mousa SAC and SPA; Noss SPA; North Fetlar SAC; Fetlar SPA; and Yell Sound Coast SAC. However, due to the low quantities of oil predicted to reach the waters and shoreline around Shetland and the remote likelihood of a major oil spill occurring, the risk of significant impact is considered to be negligible.

The risk of an accidental hydrocarbon release having a transboundary impact is recognised by the UK and Norwegian governments. Agreements are in existence for dealing with international releases with states bordering the UK (e.g., Bonn Agreement). In the event of a major accidental release, the Norwegian/ British oil spill response (NORBRIT) plan will be activated.

5.3.4 Residual impacts

When assessing accidental events, the likelihood of the event occurring must be taken into account. Based on the historical frequency of uncontrolled development well blowouts on the NCS and the project-specific measures that will be employed to further reduce the possibility of a blowout occurring, the likelihood is expected to be remote. In addition, oil spill response measures have been developed to reduce the impact of any release that does occur. Taking into account the remote likelihood of such a release occurring and the mitigation measures in place, the consequence is expected to be low and the residual impact not significant. Residual impacts are summarised in Table 5.5.

Table 5.5 Significance of residual impacts from accidental events

Receptor	Sensitivity	Vulnerability	Value	Magnitude	Likelihood	Consequence
Seabirds	High	High	High	Major	Remote	Low
Coastal protected sites	High	High	High	Moderate	Remote	Low

6 ENVIRONMENTAL MANAGEMENT

Equinor and its contractors operate their facilities according to the Equinor group's management system (as modified to reflect local conditions and regulations) and best industry practices. Equinor operates an EMS in accordance with the requirements of ISO14001. The operations described within this ES fall within the scope of the EMS. It is the aim of Equinor to ensure best environmental practices and procedures are followed and that continual improvement in environmental performance is maintained at all times.

Emergency Response Bridging Documents are prepared for all offshore activities involving contractor facilities and vessels. Management System Interfacing and procedural precedence is defined in contract documents, and for high-risk activities is further clarified by preparation of Management System Interface documents. These documents clearly define the interfaces and establish the agreed arrangements including responsibilities, systems, procedures and practices, for managing health, safety and environment during contracted works.

Chemical use and discharge will comply with Norwegian regulations and licencing requirements and as discussed in Section 2.7, no chemicals categorised as black or red will be used in connection with the development of the Barnacle well. Selection of specific chemicals will be based on BAT principle. Equinor will also be required to apply for drilling and production permits as advised by OPRED. This will be limited to a drilling master application template (MAT) and EIA drilling subsidiary application template (SAT) for the sections of the well underlying the UKCS and a production MAT with an EIA SAT for start of production. There will be no chemical permit as there is no use or discharge of chemicals in UK waters.

6.1 Environmental management and commitments

The mitigation measures implemented as part of the proposed Barnacle Field Development project are listed in Table 6.1.

Table 6.1 Proposed mitigation measures

Aspect	Commitment
Discharges to Sea	Priority for PLONOR chemicals and chemicals with a low hazard or risk quotient.
	Cement volumes controlled by careful calculation.
	Excess cement minimised by adherence to operating procedures.
	Only visibly clean fluid discharged.
	OBM cuttings recovered to the platform, contained and shipped to Norway for treatment and disposal.
Atmospheric Emissions	Adherence to strict maintenance regimes for all equipment and vessels.
	Equipment kept at optimum efficiencies to minimise fuel consumption.
	Vessels and contractors will have UK/International Air Pollution Prevention Certificates.
	Sea and air supply traffic managed to minimise number of trips.
Accidental Release	Regular review and update of contingency plans.
	Review spill mitigation measures of all contractors as part of the contractor selection process.
	Relief well plan in place for well blowout scenario.
	Blowout preventor maintained and tested regularly.
	Break away coupling for tanker transfers to minimise spillage

Since the Statfjord B platform has been in operation for a number of years, operational procedures include environmental management commitments and considerations. The Equinor Project Management team will review commitments and procedures periodically to ensure that they are being met. Objectives and targets are also used for setting goals for continuous improvement in performance as part of Equinor's EMS. In this way environmental management is an ongoing process and will continue beyond implementation of mitigation measures identified during this EIA in order to strive for continuous improvement.

6.2 Environmental Monitoring

Monitoring is an important activity for ensuring performance against both the environmental regulatory requirements and the objectives and targets specifically designed for the project. Monitoring also enables the gathering of information to track overall environmental performance. There are three inter-related drivers for such monitoring:

- Statutory requirements, e.g., chemical use and discharge and atmospheric emissions;
- Corporate or project expectations and targets; and
- Validation of predictions made during the EIA process.

Monitoring is an important activity and involves the monitoring of emissions, effluents and waste generation, and is required for a number of different purposes:

- Monitoring data for compliance with environmental consents and regulatory governmental requirements;
- To track performance against established objectives and targets (such as those described in the Commitments Register); and
- To monitor against Equinor reporting requirements.

Performance measurement for the project will include:

- Chemical use and dosing rates of chemicals;
- Total oil discharged in produced water;
- Drilling mud use; and
- Accidental release of hydrocarbons or chemicals.

6.3 Environmental awareness and training

All employees, suppliers and contractors of Equinor undergo relevant training on environmental issues. This may include one or more of the following:

- Induction training using applicable environmental awareness training modules;
- Safety management course (for supervisory and managerial employees);
- Incident investigation training (as required); and,
- Risk assessment training.

6.4 Interface with contractors

Management of contractors is an essential part of environmental management in order to ensure compliance with regulatory requirements and company policy and to ensure primacy and procedural interfaces, including management of environmental aspects, are identified and managed. The objectives of the Equinor contractor management processes are to ensure that:

- All contractors apply Health, Safety, Security and Environment (HSE) policies and standards that are compatible with Equinor policy;
- All contractors' personnel are competent to perform their tasks;
- HSE responsibilities of both contractor and Equinor are clearly defined; and
- Each contractor has a formal hazard management process to minimise HSE risk.

The above objectives are applicable to all phases of the contracting process and existing contracts are reviewed periodically

6.5 Scottish National Marine Plan

The Barnacle Field Development has considered the objectives and marine planning policies of the Scottish National Marine Plan across the range of policy topics including natural heritage, air quality, cumulative impacts and oil and gas. Equinor considers that the project is in broad alignment with such objectives and policies; the extent to which the project is aligned with the oil and gas objectives and policies is summarised in Table 6.2.

Table 6.2 Alignment between the Barnacle Field Development and the oil and gas objectives and policies of the Scottish National Marine Plan

Objective/policy	Barnacle development details
Maximise the recovery of reserves through a focus on industry-led innovation, enhancing the skills base and supply chain growth.	New oil and gas source making use of up to date and innovative technology, providing jobs and training.
An industry which delivers high-level risk management across all its operations and that it is especially vigilant in more testing current and future environments.	Extensive mitigation measures and response strategies developed for identified risks.
Continued technical development of enhanced oil recovery and exploration, according to the principles of Best Available Technique (BAT) and Best Environmental Practice (BEP).	Use of up to date and innovative technology in the development of a North Sea oil reserve, aligned with the principles of BAT and BEP.
Where possible, to work with emerging sectors to transfer the experience, skills and knowledge built up in the oil and gas industry to allow other sectors to benefit and reduce their environmental impact.	The Barnacle development will draw on experienced engineers, environmental specialists and other groups that are not necessarily limited to oil and gas experience throughout the project life time.
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.	Equinor will review decommissioning best practice closer to the point at which the Statfjord B platform is decommissioned. Full consideration will be given to available decommissioning options, including reuse and removal.
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.	The Barnacle area has been developed in a way that there will not be a significant impact on the physical, biological and socio-economic environment. This demonstrates an appropriate siting within the North Sea.
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 UK National Contingency Plan (NCP) and the Offshore Safety Directive.	Potential environmental impacts have been reviewed as part of this EIA and relevant mitigation measures developed. The Equinor response strategy to accidental hydrocarbon release has been developed with due reference to the NCP.

7 CONCLUDING STATEMENT

This ES presents the findings of the EIA conducted for the Barnacle Field Development which is located within UKCS Blocks 211/29f and 211/30c and is currently planned for a production period of seven years. Barnacle Field, located in the UKCS, will be developed with a single extended reach well drilled from the Statfjord B Platform, located in the NCS approximately 2.5 km northeast of the UK/ Norway median line. The water depth at Statfjord B is 149 m. All drilling cuttings will be re-injected in a disposal well. Drilling fluids will be re-used or shipped to shore for disposal. Statfjord B has an 83% recycling rate for oil based drilling fluids. Barnacle drilling is due to commence in August 2019 and take an estimated 90 days. Start-up of production is planned for Q4 of 2019. No new infrastructure will be needed in the UKCS to accomplish the development program.

7.1 Environmental impacts

There are no conservation or protected sites within 50 km of the proposed development area. The only Annex II species expected to occur in the area is the harbour porpoise. Potential issues from seabed disturbance, underwater noise, interaction with other users of the sea and physical presence were determined not likely to result in a significant impact, and therefore were scoped out of further assessment.

Potential impacts from the discharge of cement and produced water, emissions to air from power generation and flaring, and an accidental event from a well blowout and subsequent release of a large volume of oil, were each assessed for their significance and potential impacts to receptors.

- Discharges to sea of cement and produced water – Statfjord B platform production has been declining and even with the addition of the Barnacle field production, the volume of produced water will continue to decline over the life of the field. Before disposal to sea, produced water will be treated to well below regulatory standards. The nearest third-party infrastructure to the Statfjord B platform is 14 km and no significant cumulative impacts are expected. Therefore, it is concluded that there is no significant environment risk due to the discharges to sea from the proposed Barnacle Field Development.
- Emissions to the atmosphere – Emissions from the Statfjord B platform are expected to decrease from 2019 through to CoP in 2026, even with the inclusion of the Barnacle well. The increased production will be within the existing processing capacity of the Statfjord B platform. Statfjord B emissions have the potential to affect air quality both at local and global levels. At a local level, impacts are mitigated by control measures in place to limit emissions, and also by the dispersive nature of the offshore environment. Globally, emissions will contribute to environmental issues such as climate change. Atmospheric emissions from the Barnacle Field Development will be a relatively minor contribution to greenhouse gases in the context of the Statfjord field and equivalent emissions in the North Sea. While atmospheric emissions from the Barnacle Field Development will cross into the UK sector, this is not expected to result in significant cumulative impacts. Every effort will be made to minimise the use of fuel and flaring in order to reduce the CO_2 contribution from the platform and the proposed development.
- Accidental event, major hydrocarbon release – Accidental hydrocarbon release to the sea is often the principle environmental concern associated with offshore oil-industry activities and which could result in a number of environmental and economic impacts, the most conspicuous of which are on seabirds and coastal areas. A well blowout was selected as the worst-case hydrocarbon release with environmental impacts resulting from surface oiling, water column contamination and beached oil. Based on the modelling undertaken, it was found that spilled oil is likely to cross the UK/ Norway median line and potentially impact the coastlines of Shetland. Though the potential consequences to seabirds and protected sites around Shetland is high, due to the low quantities of oil predicted to reach the waters and shoreline around Shetland and the remote likelihood of a major oil spill occurring, the risk of significant impact is considered to be negligible.

7.2 Overall conclusion

Based on the findings of this EIA, it is concluded that the proposed Barnacle Field Development Project will not result in any significant environmental impacts. In considering the requirements of Scotland's National

Marine Plan, this conclusion confirms that the Barnacle Field Development is consistent with the objectives and policies set out, together with the sectoral policies outlined for the UK oil and gas sector.

The most substantial potential impact identified during the EIA is that of a well blowout. However, the probability of such an event occurring is very low and Equinor has in place stringent industry standard control measures.

The findings and recommendations of the EIA as presented in this ES will be carried through by formal commitments which will provide a transparent and auditable means of ensuring the measures identified will be delivered through Equinor's EMS. It is the conclusion of this ES that the current proposal to develop the Barnacle Field can be completed without causing significant impact to the environment or society.

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9 ACRONYMS

BAT	Best available technique
B_o	Oil formation volume factor
BEIS	Department of Business, Energy and Industrial Strategy
BSL	Below sea level
CaCl	Calcium chloride
CO_2	Carbon dioxide
Condeep	Concrete deep water
CPR	Continuous plankton reader
DECC	Department of Energy and Climate Change
DNV	Det Norske Veritas
DTI	Department of Trade and Industry
EC	European Community
ECD	Equivalent circulating density
EIA	Environmental Impact Assessment
EHS	Expendable hydraulic screen
EMP	Environmental Management Plan
EMS	Environmental Management System
ERD	Extended reach drilling
ES	Environmental Statement
EU	European Union
FDP	Field development plan
FLAGS	Far North Liquids and Gas System
GHG	Greenhouse gas
HRA	Habitats Regulations Appraisal
ICES	International Council for Exploration of the Sea
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IPPC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
IUCN	International Union for the Conservation of Nature
JNCC	Joint Nature Conservation Committee
kSm^3	Thousand standard cubic metres
KCl	Potassium chloride
LAT	Lowest astronomical tide
LSOBM	Low solids oil based mud
M	Metre
m^3	Cubic metre
m/s	Metres per second
MarLIN	Marine Life Information Network
MAT	Master application template

MCZ	Marine conservation zone
MD	Measured depth
MMO	Marine mammal observer
MOD	Ministry of Defence
MPA	Marine Protected Area
mPaos	Millipascal seconds
MSBL	Million standard barrels
MSL	Mean sea level
N_2O	Nitrous oxide
NaCl	Sodium chloride
NCMPA	Nature Conservation Marine Protected Area
NCP	National Contingency Plan
NCS	Norwegian Continental Shelf
NM	Nautical miles
NMPI	National Marine Plan Interactive
NNS	Northern North Sea
NOFO	Norwegian Clean Seas Association for Operating Companies
NORBRIT	Norwegian / British Oil Spill Response
NORM	Naturally occurring radioactive material
NO_X	Oxides of nitrogen
NO_2	Nitrogen dioxide
NSTF	North Sea Task Force
O_3	Ozone
OBM	Oil based muds
OCR	Offshore Chemicals Regulations
OGA	Oil and Gas Authority
OIW	Oil in water
OOIP	Original oil in place
OPPC	Offshore Petroleum Activities (Oil Pollution Prevention and Control)
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSRL	Oil Spill Response Limited
OSPAR	Oslo Paris Convention
P&A	Plug and abandon
Pa	Pascal
PDQ	Production drilling and quarters
PLONOR	Pose Little or No Risk to the Environment
PMF	Priority marine feature
Ppb	Parts per billion
Ppt	Parts per thousand
ROS	Recycled oil sump
R_s	Solution gas ratio
SAC	Special Area of Conservation

SAT	Subsidiary application template
SFLL	Statfjord Late Life
SINTEF	Scandinavian Independent Research Organisation Stiftelsen for industriell og teknisk forskning
Sm^3/d	Standard cubic metre per day
SMRU	Sea Mammal Research Unit
SNH	Scottish Natural Heritage
SOSI	Seabird Oil Sensitivity Index
SO_X	Oxides of sulphur
SO_2	Sulphur dioxide
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
THC	Total hydrocarbon concentration
TD	Total depth
TOM	Total organic matter
TD	Total depth
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
US	United States
VMS	Vessel monitoring system
VOC	Volatile organic compounds
WBM	Water-based mud
WHS	World Heritage Site