ETRK0001

ETTRICK & BLACKBIRD DECOMMISSIONING PROJECT

Completion of ESIA for Blackbird and Ettrick Decommissioning Programme

Document No: ETRK0001-GE-O000-LC-RPT-0006

Rev: U1

Rev	Date	Reason for Revision
U1	15/12/16	ISSUED FOR USE

Authorisation Record		Position of Preparer	Position of Checker	Position of Approver
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U1	15/12/16	SCH	AFE	HDR
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REPORT

Ettrick and Blackbird Decommissioning EIA

Prepared for: **Nexen Petroleum U.K. Limited**

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INFORMATION SHEET

Project name	Environmental Impact Assessment for the Decommissioning of the Ettrick and Blackbird Field Developments
Type of project	Decommissioning
Undertaken name	Nexen Petroleum U.K. Limited (Nexen)
Undertaken address	Nexen Petroleum UK LTD Discovery House, Prime Four Business Park, Aberdeen, AB15 8PU
Nexen Document Reference Number	ETRK0001-GE-O000-LC-RPT-0006
Licences/owners	Nexen Petroleum UK Limited is the nominated operator

Ettrick field interests

Nexen	80 %
Dana Petroleum (BVUK) Ltd	12 %
Atlantic Petroleum	8 %

Blackbird field interests

Nexen	90.6 %
Atlantic Petroleum	9.4 %

Short description	The Ettrick and Blackbird fields were operated by Nexen Petroleum (UK) Ltd (Nexen). Both fields were subsea developments, tied back to the Aoka Mizu Floating Production Storage and Offloading (FPSO) vessel. Hydrocarbons were processed and stored on the FPSO prior to export; oil via a shuttle tanker and gas via an export riser and pipeline system connected to the Scottish Area Gas Evacuation (SAGE) pipeline. Water Injection and gas lift were available to both fields. Production ceased at the fields in June 2016 and the FPSO went offstation on August 1st 2016. This document provides an environmental impact assessment of the activities associated with the decommissioning activities.
Anticipated date for commencement of works	Decommissioning activities captured in this document are anticipated to commence in Q1 2017 and with final over trawlability trials anticipated in Q4 2020. Post decommissioning surveys are anticipated to take place between Q2 2021 and Q3 2022.
Date and reference of any earlier environmental statements	Nexen. (2005). Ettrick Field Development Environmental Statement. DTI Project Reference No. W/2817/2005. Nexen. (2010). Blackbird Development Environmental Statement, BBD-HS-STA-00011.
Significant environmental impacts identified	None
EIA prepared by	Genesis Oil and Gas Consultancy Ltd.

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EXECUTIVE SUMMARY

The Ettrick and Blackbird (E&B) fields lie in the Outer Moray Firth Area in the Central North Sea (CNS) and are operated by Nexen Petroleum (UK) Ltd (hereafter referred to as Nexen). Nexen has prepared this Environmental Impact Assessment (EIA) under the Petroleum Act 1998, in support of four draft Decommissioning Programmes (collectively referred to here as the E&B draft Decommissioning Programmes) that are being submitted to the Department for Business, Energy and Industrial Strategy (BEIS), formerly known as the Department of Energy and Climate Change (DECC), to seek approval for the activities associated with the decommissioning of the:

(1) Ettrick installations;

(2) Ettrick pipelines;

(3) Blackbird installations; and

(4) Blackbird pipelines.

Background Information

The E&B fields lie within Quadrants 20/2a and 20/3a in the Outer Moray Firth Area *c.*120 km northeast of Aberdeen in 110 m water depth (Figure 1) and were produced via the Aoka Mizu Floating Production Storage and Offloading (FPSO) vessel. Production from the E&B fields ceased in June 2016 and the FPSO went off station on 1st August 2016.

Both fields were predominantly oil reservoirs with the FPSO providing processing capability. The oil was stored on the FPSO and batch exported via a shuttle tanker, whilst the gas was exported via a gas export riser and pipeline system connected to the Scottish Area Gas Evacuation (SAGE) pipeline. Water Injection (WI) and gas lift were available to both fields via subsea pipelines and infrastructure.

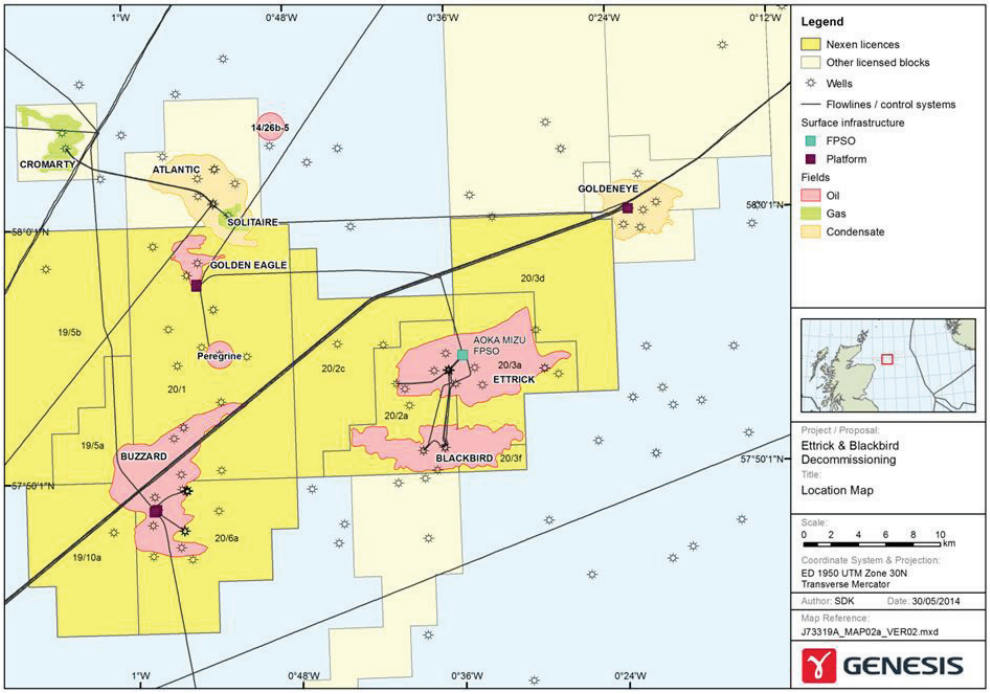

Figure 1: Location of the Ettrick and Blackbird field.

Decommissioning Activities

Nexen propose to Plug and Abandon (P&A) and decommission the E&B fields in four phases/scopes:

- Phase 1: Subsea scope 1 which includes recovery of the Detachable Turret Buoy (DTB), risers, dynamic umbilical's, Mid Water Arch (MWA) and moorings;
- Phase 2: Well P&A;
- Phase 3: Subsea scope 2 which includes recovery of manifolds, Subsea Safety Isolation Valve (SSIV), Subsea Distribution Unit (SDUs), jumpers, transition ends and exposed sections of pipelines and umbilicals. Grout bags and mattresses will also be recovered during this phase;
- Phase 4: Post decommissioning survey.

The overall decommissioning programme is expected to last approximately six years.

Infrastructure to be recovered as part of the decommissioning activities includes:

- Mooring anchors and mooring chains;
- All wellheads;
- All subsea infrastructure (arches, skids manifolds etc.);
- All surface laid risers, spools, jumpers and umbilicals; and
- Concrete mattresses and grout bags.

A comparative assessment was carried out for the trenched and buried E&B pipelines and umbilicals. The assessment favoured a combination of the following two options:

- Rock cover transition ends and cut and remove exposed pipeline sections; and
- Bury transition ends and rock cover exposed sections.

Environmental and Socio-Economic Baseline

The seabed in the vicinity of E&B subsea infrastructure is relatively flat at depths of between 90 and 130 m. The water currents in the E&B development area are predominantly driven by the Fair Isle Current and the Dooley Current moving in an anticlockwise direction. The sediment in the area of the Ettrick subsea infrastructure is sand and muddy sand and the sediment in the area of the Blackbird development is predominantly fine silty sand to very fine sands.

No evidence of sensitive habitats protected under Annex I of the EU Habitats Directive have thus been found at the E&B developments.

Pockmarks have been seen in the Blackbird area, associated with the near surface geology of the Witch Ground Formations. In the proximity of the development itself a few small seabed depressions and one large depression were identified, all of which have been attributed to scour around boulders. The detected pockmarks showed no evidence of gas leakage or Methane Derived Authigenic Carbonate (MDAC) structures.

Lophelia pertusa is known to occur as marine growth on offshore installations in the North Sea (OGUK, 2013), however surveys carried out at the E&B developments have not identified the presence of this freshwater coral.

The planktonic assemblage in the area of the Blackbird and Ettrick Developments is considered typical of the North Sea. The benthic infaunal communities in the E&B area are

typical of the CNS with the normal polychaete dominated structure exhibiting high diversity and moderate abundances.

Known fish spawning and nursery grounds in the vicinity include whiting, lemon sole, Norway pout, sprat, *Nephrops* and sandeel. A number of the species identified have been assessed by Scottish Natural Heritage (SNH) and Joint Nature Conservation Committee (JNCC) as Priority Marine Features (PMF) in Scotland. Marine Scotland has registered a 'period of concern' for seismic and drilling activity in the vicinity of Block 20/02 and Block 20/03 from February to June.

Harbour porpoise, minke whale, white-beaked dolphin, white-sided dolphin, Risso's dolphin and killer whale have been sighted in the area. Data indicate that minke whale, killer whale, bottlenose dolphin, white-sided dolphin and Risso's dolphin occur in relatively low abundance. The densities of white-beaked dolphin and harbour porpoise vary from low to high throughout the year but appear to be relatively high in the summer months. Given the distance of the E&B fields from the coast it is unlikely that harbour seals will occur. It is possible that grey seals may forage in the area, however based on observed foraging ranges numbers would be expected to be low.

Seabird vulnerability throughout the year varies from low (January and May), moderate (March, April and December) and high (February, June and November) to very high (July to October). Overall annual vulnerability is classed as high.

There are a number of protected sites within the vicinity of the E&B fields, the nearest being the Turbot Bank Nature Conservation Marine Protected Area (NCMPA) *c*. 40km south of Block 20/2. The nearest Site of Community Importance to the E&B developments are the Braemar Pockmarks and the Scanner Pockmark Special Areas of Conservation (SACs) which lie c. 150 km east northeast and 93 km northeast of Block 20/3 respectively. The nearest onshore protected site is the Buchan Ness to Collieston Coast Special Protection Area (SPA), which is c.70 km southwest of the developments.

Shipping activity within the area of the E&B fields is considered moderate. Fishing effort by UK vessels (number of vessel days) within the area is considered to range from relatively low to moderate.

Blocks 20/2 and 20/3 are located within a well-developed oil and gas region. The nearest surface installations are the Goldeneye, the Golden Eagle and the Buzzard Platforms located c.15 km, 16 km and 25 km respectively from Ettrick.

The closest windfarm development to the E&B developments is the Moray Firth Windfarm which is located c.105 km northwest of the blocks.

Impact Assessment

Central to the EIA process is the requirement to identify activities that could cause harm to the environment or other users of that environment. As such, an Environmental Impact Identification (ENVID) workshop was undertaken to facilitate identification of the environmental and social impacts associated with the project.

Energy Use and Emissions to Air

Emissions resulting from fuel use by the vessels and during recycling of recovered materials will produce greenhouse gases and make a very small contribution to climate change. Standard mitigation measures to optimise energy usage by vessels will include operational practices and power management systems for engines, generators and any other combustion plant and planned preventative maintenance systems for all equipment for peak operational efficiency.

Discharges to Sea

There is the potential for small quantities of residual chemicals and hydrocarbons to be released into the water column from lifting of subsea infrastructure and from vessels used for decommissioning. The seabed and the water column are the primary receptors. Mitigation includes a successful post Cessation of Production (COP) deoiling programme, chemical selection processes, permitting of hydrocarbon and chemical discharges and strict vessel operating procedures. All of these impacts will be localised and short term given the highly dynamic environment around E&B

Solid Deposits on the Seabed and Disturbance to Seabed

The principal sources of seabed disturbance associated with the E&B decommissioning activities concern the removal of structures, spools, mattresses and grout bags, cutting operations, anchoring of the semi-submersible drilling rig and the placement of additional rock cover (estimated at *c.* 11,000 te) on the exposed pipeline ends. These activities will result in the displacement of substrate and the suspension and subsequent settlement of sediment.

The species and habitats observed in the vicinity of the E&B fields are relatively widespread throughout the CNS and the area anticipated to be impacted represents a very small percentage of the available habitat. All disturbed sediments are expected to recover rapidly though recruitment from adjacent undisturbed areas.

Measures to control disturbance include operational planning, minimisation of rock placement where possible and equipment selection.

Due to the localised and relatively short duration of the decommissioning activities, and with the identified control and mitigation measures in place, the overall significance of the impact of seabed disturbance as a result of the decommissioning of E&B fields is considered to be low.

Underwater Noise

The main sources of underwater sound associated with the proposed decommissioning activities at E&B include acoustic surveying equipment, vessels, cutting tools and other diver tools and placement of rock cover.

Sound is important for marine mammals for navigation, communication and prey detection. Anthropogenic sound may interfere with acoustic communication, predator avoidance, prey detection, reproduction and navigation in fish. Although there are marine mammals and fish in the area around the E&B field, disturbance from noise resulting from decommissioning activities is expected to be low. The greatest potential disturbance is as a result of vessels using Dynamic Positioning (DP). However, given that E&B are in an area of established oil and gas activity, marine mammals are likely to be accustomed to similarly sound levels and this reduces the severity of impact.

Waste Management and Resource Use

The subsea infrastructure removed from the E&B fields will be transported to shore for re-use, as materials for recycling or as waste for appropriate disposal. The potential impacts from waste disposal are on the onshore environment and are principally associated with the potential impacts of landfills. Overall, decommissioning puts resources back into use through re-use of equipment and recycling of materials such as steel. However, where infrastructure

is left in situ (e.g. trenched and buried flowlines and umbilicals) this material is effectively "lost".

Accidental Events

The following decommissioning activities have been identified as having the potential to results in an accidental release of hydrocarbons:

- Well blowout; and
- Vessel collision resulting in a spill of diesel.

Each well is fully suspended with two proven barriers to the environment and all tree structures are overtrawlable. Therefore, in terms of risk of a well blowout scale event, the "likelihood" remains low, the same as under normal operating conditions. In addition, the reservoirs are depleted, each well has been bullheaded to push hydrocarbon away from the wellbore and back into the reservoir, and no lift force is being applied so the wells are not under pressure. As a result, the "consequence" of a large scale release, in terms of volume and rate from the wells, is greatly reduced compared to normal operations which lowers the overall risk. For the purposes of this EIA it is realistic to assume that in the event of a worst case scenario, where for example a Xmas Tree is ripped off and the completion tubing and Sub Surface Safety Valve are damaged and lose integrity, unconstrained flowrates, as declared in the Oil Pollution Emergency Plan (OPEP), would not occur or persist. The volumes of hydrocarbons released from any of the wells during P&A activities is therefore considered to be minimal.

Nexen has well developed procedural controls in place to minimise the likelihood of releases and to mitigate the impacts of releases should they occur, as set out in the Ettrick area OPEP. Nexen have a contract with Oil Spill Response Limited (OSRL). They would be mobilised in the event of a larger spill in order to provide trained personnel, equipment and additional logistics. The OPEP also sets out the requirements for staff competency and training. Emergency Control Exercises are conducted every three years.

A vessel collision could result in the loss of fuel inventory from one of the vessels on site, however given that diesel tends to evaporate rapidly the environmental impact of such a release is considered to be relatively localised (no beaching and short term effect). In addition with identified mitigation measures in place the likelihood of such an even is considered remote.

Each vessel used during decommissioning will have its own Shipboard Oil Pollution Emergency Plan (SOPEP). Only vessels which meet Nexen's assurance standards will be used and all vessels will be assessed prior to the start of the contract. Risks associated with simultaneous operations will be assessed before the decommissioning activities are carried out.

The measures that are in place in the E&B fields are considered effective in minimising the risk of a hydrocarbon oil release during decommissioning activities to ALARP.

Socio-Economic Impacts

During the decommissioning activities, access to some areas along the pipelines may be temporarily restricted while rock cover is placed. The detailed timing and location of the decommissioning operations will be published in the Kingfisher Bulletin to minimise disruption to other users of the sea.

Following completion of the decommissioning activities, Nexen will commission a debris clearance sweep using specially designed trawling equipment. Any debris retrieved will be returned to shore for recycling/disposal.

The key mitigation in relation to minimising impacts on fishing is through the selection of appropriate decommissioning options for all seabed infrastructure. This was undertaken in consultation with Scottish Fisherman's Federation (SFF) and Nexen will continue to consult with SFF throughout the decommissioning works. Over-trawlable studies will be undertaken to check for any potential snagging hazards.

Following decommissioning, the 500 m exclusion zones around the DTB and the E&B drill centres, will be relinquished and the area will be made available for fishing.

Overall socio-economic impacts in relation to shipping, fishing and employment resulting from the decommissioning activities are considered to be low.

Environmental Management

Procedural and technical controls and mitigation measures identified in the preparation of this EIA to reduce impacts to a level that is 'as low as reasonably practicable' are summarised in Table 1 below:

Table 1: Decommissioning of Ettrick and Blackbird fields: mitigation measures

Aspect	Commitment
Atmospheric emissions and energy use	• Prior to mobilisation, vessels will be selected and assessed to ensure maintenance of generators and engines which leads to better efficiency in line with manufacturer's specifications; and • Decommissioning vessel schedules will be planned to optimise (minimise) vessel use.
Discharges to sea	• Released chemicals will be permitted under the UK Offshore Chemical Regulations; • Chemical risk assessments will be undertaken in order to obtain approval for use of chemicals; • Any releases of Naturally Occurring Radioactive Material (NORM) to sea will be minimised and within currently authorised levels; • Operating procedures and systems for optimum performance will be used to control and minimise discharges from vessels; • All vessels will be assessed prior to final selection to ensure necessary controls are in place; and • Suitable technology for cutting the well heads will be selected to ensure the effectiveness and minimise the duration of the cutting operations.
Solid deposits on the seabed and disturbance to the seabed	• All activities which may lead to seabed disturbance will be planned, managed and implemented in such a way that disturbance is minimised; • A seabed survey will be carried out and detailed anchoring plans for the drilling rig will be put in place; • Rock placement will only be undertaken in limited areas for the pipelines which are remaining in situ, and in line with the options selected at the comparative assessment; • A fall pipe will be used to direct the rock cover to the correct location; • Careful planning, selection of equipment, and management and implementation of activities (especially water-jetting); • All dropped objects will be reported to BEIS via a Petroleum Operations Notice (PON) 2 and Nexen will aim to recover all dropped objects; and • A debris survey will be undertaken at the completion of the decommissioning. Any debris material, identified as resulting from decommissioning activities will be recovered from the seabed where possible. Those not recovered will be entered into the FishSafe database.
Underwater noise	• Vessel use will be optimised; and • Cutting locations and procedures identified in order to minimise number and duration of operations.
Waste management and resource use	• Where possible, materials will be recycled or sold and reused; • Waste management options will take account of the waste

Aspect	Commitment
	hierarchy; • Existing waste disposal routes and contractors will be used where possible; • Segregating materials at source and maintaining this separation between hazardous and non-hazardous waste streams will reduce the amount of material requiring treatment onshore; • If hazardous waste is produced it will be pre-treated to reduced hazardous properties or, where possible render it non-hazardous; and • NORM contaminated equipment will be handled, transported, stored and disposed of in a controlled manner. Protocols will be in place to ensure that equipment is not released or handled without controls to protect the worker and prevent contamination of the environment.
Accidental events	• Only vessels which meet Nexen's vessel assurance standards will be used; • Each vessel used during decommissioning will have its own Shipboard Oil Pollution Emergency Plan; and • Nexen have a contract in place with Oil Spill Response Limited.
Socio-economic impacts	• Selection of appropriate decommissioning options for all seabed infrastructure; and • Over-trawlable studies will be undertaken to check for any potential snagging hazards.

Conclusion

This EIA has assessed the impacts and risks associated with the proposed decommissioning activities in the context of the environment within which the E&B fields and infrastructure are situated. With implementation of the proposed mitigation measures, the environmental impact of the removal of the facilities is likely to be temporary with regard to disturbed seabed within the project footprint. Recovery of the Seabed is expected to begin immediately on completion of the activities. Rock placed over cut pipe ends and short lengths of exposed pipelines to make the seabed safe for fishing will have a long-term presence, but will be very limited in extent. The proposed approach to decommissioning the E&B facilities will remove man-made structures from the seabed, leaving it in a condition suitable for re-colonisation by local species and safe for fishermen.

ABBREVIATIONS

AHV	Anchor Handling Vessel
ALARP	As Low As Reasonably Possible
BEIS	Department for Business, Energy and Industrial Strategy
BOD	Biochemical Oxygen Demand
BODC	British Oceanographic Data Centre
CA	Comparative Assessment
CITES	Convention on International Trade in Endangered Species
CH_4	methane
CNS	Central North SEA
COP	Cessation of Production
CO_2	carbon dioxide
CO_{2e}	CO_2 equivalent
cSAC	candidate SAC
CSV	Construction Support Vessel
CtL	Consent to Locate
dB	decibels
DCM	Drill Centre Manifold
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Fisheries and Rural Affairs
DoC	Depth of Cover
DoL	Depth of Line
DP	Dynamic Positioning
dSAC	draft SAC
DSV	Dive Support Vessel
DTB	Disconnectable Turret Buoy
EC	European Commission
EDCM	Ettrick Drill Centre Manifold
EIA	Environmental Impact Assessment
ENVID	Environmental Impact Identification
EPS	European Protected Species
EU	European Union
FPSO	Floating, Production, Offloading and Storage
GEAD	Golden Eagle Area Development
GWP	Global Warming Potential
HSE&SR	Health, Safety, Environment & Social Responsibility
ICES	International Council for the Exploration of the Seas
IHM	Inventory of Hazardous Materials
IoP	Institute of Petroleum Guidelines
JNCC	Joint Nature Conservation Committee
kHz	kilo-hertz
km	kilometres
LSA	Low Specific Activity
m	Metres
m^2	square metres
MAT	Master Application Template
MCAA	Marine and Coastal Access Act
MDAC	Methane Derived Authigenic Carbonate
MEG	Monoethylene Glycol
mm	millimetres
MPA	Marine Protected Area
MSV	Multipurpose Support Vessel
MWA	Mid Water Arch
NO_x	Nitrogen Oxides
N_2O	Nitrous Oxide
NCMPA	Nature Conservation Marine Protected Area
nm	nautical mile
NNS	Northern North Sea
NORM	Naturally Occurring Radioactive Material
OBM	Oil Based Mud
OCR	Offshore Chemicals Regulations
OCNS	Offshore Chemicals Notification Scheme
OPEP	Oil Pollution Emergency Plan
OPPC	Oil Pollution Prevention and Control
OSCAR	Oil Spill Contingency and Response
OSPAR	Oslo and Paris Convention for the protection of the Marine environment of the North East Atlantic
OSRL	Oil Spill Response Limited
OVI	Offshore Vulnerability Index
P&A	Plug and Abandonment
PAH	Polycyclic Aromatic Hydrocarbons

PETS	Portal Environmental Tracking System
PLEM	Pipeline End Manifold
PLONOR	Poses Little Or No Risk
PMF	Priority Marine Features
PON	Petroleum Operations Notice
ppt	parts per thousand
pSAC	possible SAC
pMPA	Possible MPA
rms	root-mean-square
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SAGE	Scottish Area Gas Evacuation
SCI	Site of Community Importance
SDU	Subsea Distribution Unit
SFF	Scottish Fisherman's Federation
SNH	Scottish Natural Heritage
SNS	Southern North Sea
SO_2	Sulphur Dioxide
SOPEP	Shipboard Oil Pollution Emergency Plan
SPA	Special Protection Area
SPL	Sound pressure level
SSIV	Subsea Safety Isolation Valve
SSS	Side Scan Sonar
Te	Tonnes
TOC	Total organic carbon
TOM	Total Organic Matter
UKCS	United Kingdom Continental Shelf
UKMS	United Kingdom Management System
UKOOA	United Kingdom Offshore Operations Association (now known as Oil and Gas UK)
VMS	Vessel Monitoring Systems
VOC	Volatile Organic Compound
WFD	Waste Framework Directive
WEEE	Waste Electrical and Electronic Equipment
WI	Water Injection
WMP	Waste Management Plan
µPa	micropascal

1.0 INTRODUCTION

The Ettrick and Blackbird (E&B) fields lie in the Outer Moray Firth Area in the Central North Sea (CNS) and are operated by Nexen Petroleum (UK) Ltd (hereafter referred to as Nexen). Nexen has prepared this Environmental Impact Assessment (EIA) under the Petroleum Act 1998, in support of four draft Decommissioning Programmes (collectively referred to here as the E&B draft Decommissioning Programmes) that are being submitted to the Department for Business, Energy and Industrial Strategy (BEIS), formerly known as the Department of Energy and Climate Change (DECC), to seek approval for the activities associated with the decommissioning of the:

(1) Ettrick installations;

(2) Ettrick pipelines;

(3) Blackbird installations; and

(4) Blackbird pipelines.

1.1 Project Background

The E&B fields lie within Quadrants 20/2a and 20/3a in the Outer Moray Firth Area *c.*120 km northeast of Aberdeen in 110 m water depth (Figure 1-1) and were produced via the Aoka Mizu Floating Production Storage and Offloading (FPSO) vessel. Production from the E&B fields ceased in June 2016 and the FPSO went offstation on 1st August 2016.

Both fields were predominantly oil reservoirs with the FPSO providing processing capability. The oil was stored on the FPSO and batch exported via a shuttle tanker, whilst the gas was exported via a gas export riser and pipeline system connected to the Scottish Area Gas Evacuation (SAGE) pipeline. Water Injection (WI) and gas lift were available to both fields via subsea pipelines and infrastructure.

Table 1-1 shows the interests held by each partner in each field.

Table 1-1: Ownership of the Ettrick and Blackbird fields.

Field partners	% ownership
Ettrick field interests	
Nexen	80 %
Dana Petroleum (BVUK) Ltd	12 %
Atlantic Petroleum	8 %
Blackbird field interests	
Nexen	90.6 %
Atlantic Petroleum	9.4 %

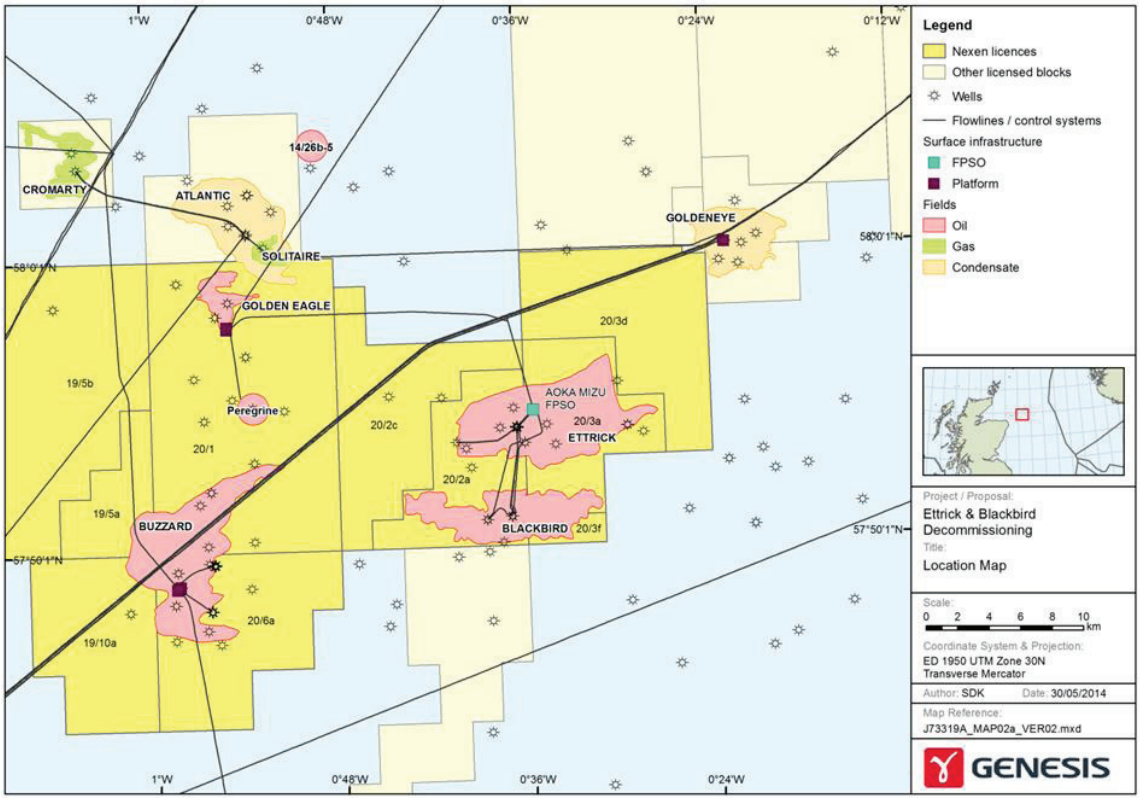

Figure 1-1: Location of the Ettrick and Blackbird field.

1.2 Purpose of This Document

Under Section 6 of the Decommissioning of Offshore Oil and Gas Installations and Pipelines under Petroleum Act 1998 Guidance Notes (DECC, 2011) there is a requirement for an EIA to be carried out for the selected decommissioning options. This document presents the results of that EIA.

The EIA identifies those activities likely to have an environmental impact. An ENVironmental Impact IDentification (ENVID) workshop was undertaken to discuss the proposed activities and their potential environmental aspects (e.g. emissions to air, discharges to sea, seabed disturbance, underwater noise and waste). The workshop also identified the mitigation measures that will be used to reduce the environmental impact associated with these aspects. Socio-economic impacts were also considered in the ENVID and are captured in this EIA.

1.3 Regulatory Context

The UK's international obligations on decommissioning are governed principally by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (the OSPAR Convention, OSPAR 1992). The UK's international obligations on the decommissioning of offshore installations are set out in OSPAR Decision 98/3 (OSPAR 1998), however, pipelines and umbilicals are not included in this Decision.

In the UK, decommissioning is regulated by BEIS under the Petroleum Act 1998 as amended by the Energy Act 2008 such that the decommissioning of pipelines must satisfy the requirements of the Petroleum Act, 1998. Pipelines are assessed on a case-by-case

basis and all feasible decommissioning options should be considered and included in a comparative assessment (CA). The CA must take account the safety, environmental, technical, societal and cost considerations of the feasible options. Cost impact may only be considered a determining factor when all other criteria emerge as equal.

As noted in Section 12.1 of the BEIS Guidance Notes (DECC, 2011), the draft Decommissioning Programmes must be supported by an EIA. The Guidance Notes state that an EIA should include an assessment of:

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

Under the Marine and Coastal Access Act 2009 (MCAA) (Her Majesty's (HM) Government, 2009) a licence application will be required at the time of decommissioning capturing the detail of all the proposed activities and assessing their impact.

Other relevant legislation includes:

- The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (HM Government, 2001);
- The Offshore Chemicals Regulations 2002 (HM Government, 2002);
- The Offshore Petroleum Activities (Oil Pollution Prevention and Control (OPPC)) Regulations 2005 (HM Government, 2005b) and as amended 2011 ;
- The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 (requiring an Oil Pollution Emergency Plan (OPEP)) (HM Government, 1998);
- The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (HM Government, 1999);
- Environmental Protection Act 1990 (HM Government, 1990);
- Special Waste Regulations 1996 (HM Government, 1996);
- Hazardous Waste (England and Wales) Regulations 2005 (HM Government, 2005a); and
- Trans-frontier Shipment of Waste Regulations (HM Government, 2007);

Cross-boundary cooperation between the UK and Norway with regard to petroleum activities is covered by a Framework Agreement (April 2005, entered into force July 2007). The agreement states that with respect to decommissioning, plans are subject to the approval of the Government on whose continental shelf or in whose territorial waters the installation is situated, after full consultation with the other Government. There are no cross-boundary pipelines and the E&B fields are *c.*142 km away from Norwegian waters, therefore no consultation with the Norwegian Government would be required. However, any transboundary impacts do need to be considered in the EIA (e.g. oil spill modelling). Any waste shipped to a country other than the UK comes under the Trans-frontier Shipment of Waste Regulations as listed above.

1.4 Stakeholder Consideration

Consulting with stakeholders is an important part of the decommissioning EIA process. It allows any concerns or issues which stakeholders may have, to be communicated and addressed. Table 1-2 summarises the informal stakeholder engagement process undertaken to date. Statutory consultees have been engaged early on in the life of the E&B Decommissioning project and were invited to participate to the comparative assessment exercise to ensure their recommendations were taken into consideration at the early stages of the project. Section 2.5.1 summarises the findings from the CA. It is worth highlighting that as part of this informal consultation phase no major concern or outstanding issues were raised.

It is worth highlighting that as part of this pre-consultation stage no concern or outstanding issues have been raised.

The formal statutory and public consultation process will be triggered by the submission of the consultation draft of the Decommissioning Programmes and supporting documents (including this EIA report) to BEIS.

Table 1-2: Third party consultations.

Consultee	Date	Description
Marine Scotland (MS)	12th June 2014	Project brief ahead of Comparative Assessment
MS, Scottish Fishermen's Federation (SFF) Joint Nature Conservation Committee (JNCC)	17th June 2014	Comparative Assessment
JNCC	5th November 2015	Project update meeting
SFF	23rd November 2015	Project update meeting
MS	1st December 2015	Project update meeting
JNCC	3rd May 2016	Pre-CoP update meeting

1.5 Environmental Management

Nexen is committed to conducting activities in compliance with all applicable legislation and in a manner that will minimise impacts on the environment. The proposed decommissioning activities will be delivered in compliance with Nexen's Environmental Management System which has been developed to align with the British Standard, BS EN ISO 14001.

The high level Health, Safety, Environment & Social Responsibility (HSE&SR) objectives of the project will comply with all safety and environmental legislation applicable to UK offshore developments; and will comply with Nexen's Corporate and UK HSE&SR Policies.

Nexen operates a formalised UK Management System (UKMS). Health, Safety and Environmental Management is integrated fully into the UKMS Framework.

The Health, Safety and Environmental Management element of Nexen's UKMS is composed of nine commitments, as follows:

1. Identify and control conditions, behaviours and processes that could pose hazards to personnel, members of the public, the environment or The Company property;

2. Effective management of incident reporting, investigation and correction;
3. Apply the principles of risk-based Process Safety Management on all assets;
4. Effective management of unexpected emergency events to minimise their impacts;
5. Measure Health Safety and Environment performance to ensure compliance with stated requirements;
6. Promote a safe and healthy working environment, and prevent occupational injuries and illnesses;
7. Communicate Health, Safety and Environment information to personnel;
8. Effectively manage emissions, waste and environmental liabilities resulting from their activities throughout the life of field operations; and
9. Participate in industry Health Safety and Environmental initiatives.

The Project has established an approach to risk management, whereby the design aims to eliminate, prevent, control and only then mitigate identified HSE&SR risks. Emergency response measures shall be implemented in line with the residual risk associated with Project activities.

Nexen recognises that management contributes significantly to long term business success. Nexen UK's HSE policy is provided in Figure 1-2.

Nexen UK's Commitment to

Health, Safety, Environment & Social Responsibility

This Policy Commitment underpins the requirements outlined in the Nexen Energy ULC Corporate HSE&SR Policy statement (A136), and applies to all activities carried out by and under the control of Nexen UK.

Within Nexen Petroleum UK, the UK Board owns and takes responsibility for our overall HSE&SR performance. We believe that management and staff commitment to HSE&SR is essential to ensuring a healthy, safe and environmentally acceptable operating environment.

We see our people are our most important asset and we will not compromise our HSE&SR standards to achieve other corporate goals, in so far as it is reasonably practicable. As such, we value the experience, professionalism and integrity of our workforce, and the commitment, leadership and accountability of all personnel for our HSE&SR performance.

We will integrate HSE&SR planning and management into our day-to-day activities, defining individual responsibilities, authority and accountability. By providing adequate control of HS&E risks arising from our work activities, we will strive to prevent accidents, injuries and cases of work related ill health, damage to equipment and the environment.

We will meet all applicable regulatory requirements, as well as other requirements to which we subscribe, and strive to deliver continuous improvement in our HSE&SR performance.

Occupational Health and Personal Safety

Nexen UK will consult with our people on matters affecting their health and safety working conditions, plant and equipment, and provide appropriate HSE&SR information, instruction, training and supervision to employees and contractors.

We will strive to optimise the safety of all our worksites by contracting those contractors who can demonstrate that they have suitable HS&E performance and management systems in place.

In addition, we will ensure that emergency response capability is in place and periodically tested for all Company operations and facilities.

We will ensure all workers are competent to carry out their tasks, in so far as they can impact on the health and safety of themselves and those around them, or the environment.

Nexen UK will maintain safe and healthy working conditions, by providing and maintaining safe plant and equipment, and ensuring that the use and handling of substances is carried out safely.

Process Safety

Nexen UK will apply the principles of Process Safety Management to maintain the integrity of our operations.

We will ensure that risks associated with major accident hazards, arising out of our offshore operations, are identified and controlled.

Environmental Management

Nexen UK is committed to integrating responsible environmental management into all aspects of its operations.

Our EMS provides the framework for setting and reviewing environmental targets and objectives, and the process by which the EMS is documented, implemented and maintained. Our actions will support the prevention of pollution and the reduction of waste generation.

Social Responsibility

Nexen is committed to behaving ethically and to contribute to economic development while improving the quality of life of the workforce and their families as well as the local community within the sphere of our activities.

At regular intervals the Board of Nexen UK will review and revise this policy, as necessary. The directors of the Company each individually and collectively share the commitment and will seek to act as directors in accordance with the above principles.

Ray Riddoch
Nexen Petroleum (U.K.) Ltd MD

Mike Backus
VP Operations

ECN-HS-POL-00065 Revision 6, August 2015

Figure 1-2: Nexen's HSE policy.

2.0 PROJECT DESCRIPTION

This section describes the E&B facilities to be decommissioned and outlines the proposed decommissioning activities. Plug and Abandonment (P&A) of the wells is covered by separate regulatory requirements and therefore outside the scope of this EIA. However, for completeness and clarity, the measures planned for the P&A activities are outlined in this document. Prior to sail away the preparatory works associated with flushing and cleaning of the Aoka Mizu topsides and subsea infrastructure were captured in the facilities production permits and are therefore only referenced here for completeness.

2.1 Field Overview

The Ettrick development was originally commissioned in 2009, and comprises seven production wells and two WI wells. All the wells are clustered around the Ettrick Drill Centre Manifold (EDCM), with the exception of one of the WI wells, which is tied back *c.* 4 km to the EDCM (Figure 2-1). The EDCM was tied back *c.*1.5 km to the FPSO by four flexible flowlines; two production, one WI and one gas lift flowline, and one umbilical.

The Blackbird development was commissioned in 2011 and lies *c.* 6 km south of the Ettrick development. The development comprises two production wells and one WI well tied back to the Blackbird manifold. Controls at the Blackbird manifold were provided by an umbilical routed directly from the FPSO whilst production was routed to the FPSO via the EDCM. An 8” WI pipeline connects the EDCM to the Blackbird WI whilst a 3” gas lift pipeline connects the EDCM to the Blackbird manifold (Figure 2-2).

An appraisal well at the Blackbird field will also be abandoned as part of this workscope.

Oil was exported from the Aoka Mizu (Figure 2-3) via shuttle tanker.

Gas was exported via a 6 km 6” flexible flowline connected to the SAGE pipeline via a pipeline end manifold (PLEM). The PLEM will remain in operation following E&B decommissioning as it is utilised for the Golden Eagle Area Development (GEAD) tie-in to the SAGE pipeline.

Full details of the installations and pipelines to be decommissioned are provided in the draft Decommissioning Programmes (Nexen, 2016a) and summarised in Section 2.2 of this document

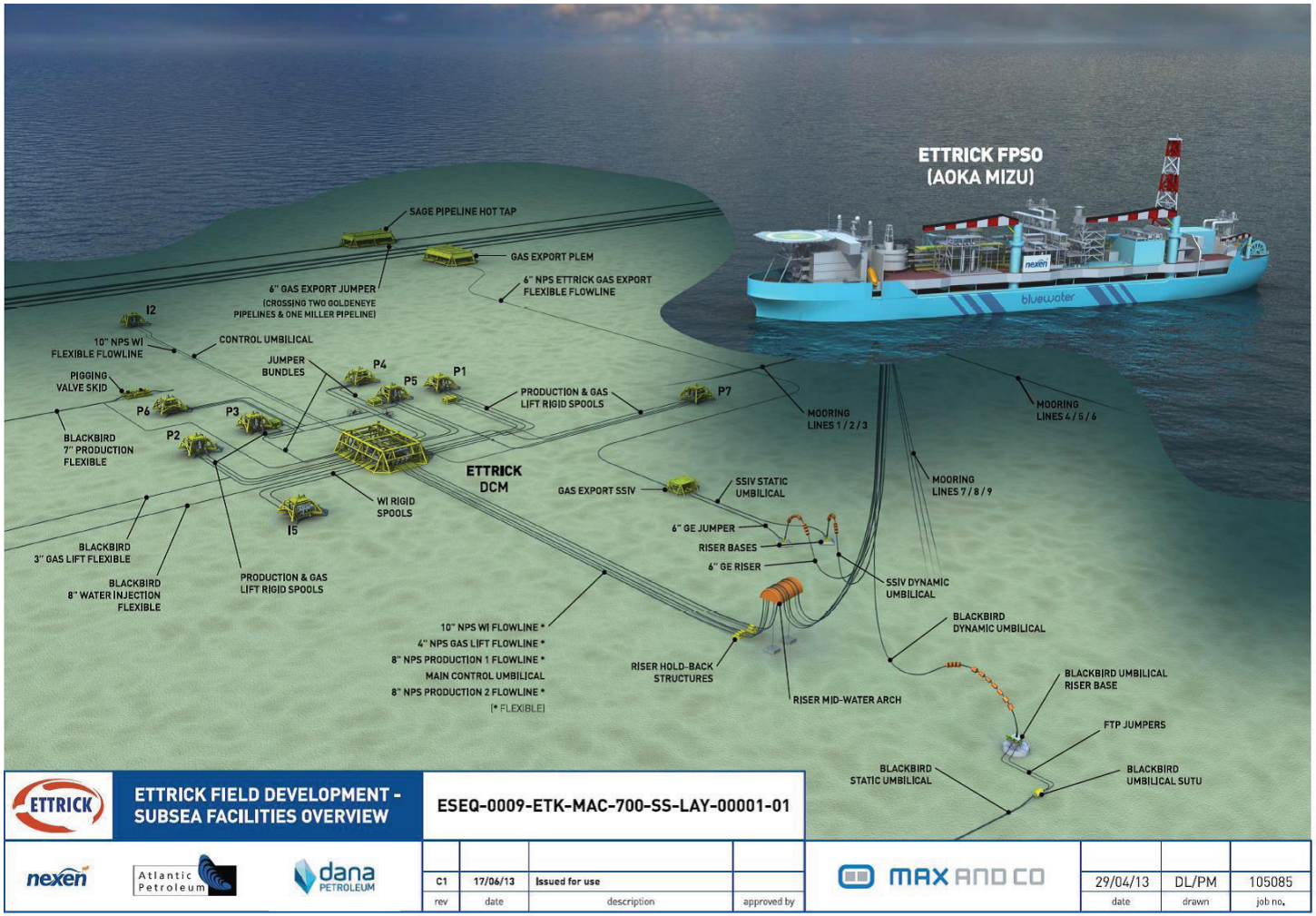

Figure 2-1: Schematic showing the Ettrick Field development layout.

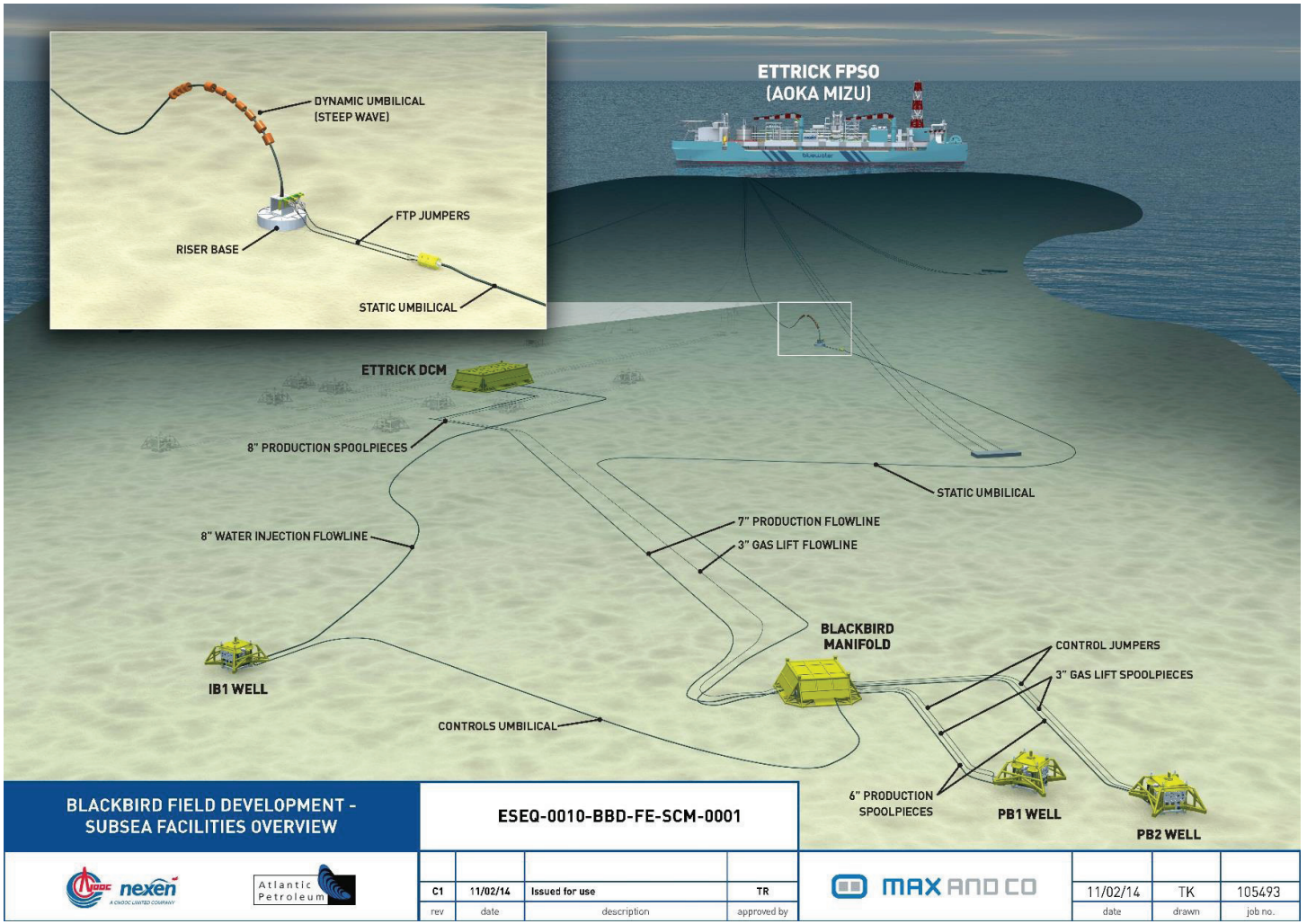

Figure 2-2: Schematic showing the Blackbird Field development layout.

Figure 2-3: The Aoka Mizu FPSO.

2.2 Ettrick and Blackbird Subsea Infrastructure

The subsea infrastructure associated with the E&B fields is summarised in Table 2-1. The lengths provided include the short sections recovered to date (as described in Section 2.3.3). Only a summary of the infrastructure is provided here whilst the draft Decommissioning Programmes contain more detailed information on each item (Nexen, 2016a). Note the umbilical jumpers (Item 8 in Table 2-1) are on the seabed as bundles similar to those shown in Figure 2-4. Within the bundles there is an electric cable and a number of hoses (range from 1 to 12) that were used to transport the required chemicals including: wax inhibitors, methanol, asphaltene inhibitors, corrosion inhibitors and hydraulic fluids.

Table 2-1: Summary of subsea infrastructure associated with the Ettrick and Blackbird Developments.

Item no.	Structure	Tag	Total length of lines (km)			
			Total length	Trenched & buried (with occasional rock cover)	In water column (risers/dynamic umbilicals)	On the seabed
Pipelines						
1	Production flowlines	PL2443 PL2444 PL2799	9.034	8.157	0.537	0.340
2	Production spools/jumpers	Various	0.520	0.000	0.000	0.520
3	Water injection flowlines	PL2446 PL2446JI2 PL2919	12.506	11.815	0.268	0.423
4	Water injection spools/jumpers	Various	0.040	0.000	0.000	0.040
5	Gas lift and gas export flowlines	PL2445 PL2448 PL2800	13.590	12.759	0.471	0.360
6	Gas lift and export spools/jumpers	Various	0.460	0.000	0.000	0.460
7	Umbilicals	PLU2447 PLU2447JI2 PLU2449 PLU2801 PLU2802 PLU2920	16.242	14.993	0.759	0.490
8	Umbilical jumpers	Various	0.935	0.000	0.000	0.935
	Structure	**Quantity**	**Description**			
Subsea installations						
9	Xmas trees and associated subsea	12	7.9 m (L) x 7.9 m (W) x 5.3 m (H). Note the control modules are mounted on			

	control modules and wellheads (9 production and 3 WI) and well		the Xmas trees. All Xmas trees have an integrated protection structure.
10	Blackbird appraisal well wellhead	1	Ø 7 m X 5 m (H)
11	Manifold	2	20.5 m (L) x 14.9 m (W) x 5 m (H) and 11.5 m(L) x 7.8 m (W) 3 m (H) Both secured with four piles
12	Subsea Safety Isolation Valve (SSIV)	1	Dimensions: 8.9 m (L) x 7 m (W) x 3.68 m (H). Gravity based structure.
13	Subsea Distribution Unit (SDU)	4	Dimensions: 1.8 m (L) x 1.5 m (W) x 1 m (H) Gravity based structure.
14	Valve skids	2	Dimensions: 3.4 m (L) x 0.9 m W) x 1.3 m (H) and 2.9 m (L) x 0.9 m (W) x 1.0 m (H) Gravity based structures.
15	Pigging skid	1	Dimensions: 6.3 m (L) x 4.3 m (W) x 0.9 m (H). Gravity based structure.
16	Riser base/holdback structures	5	Various dimensions: maximum 12 m (L) x 6.8 m (W) x 1.3 m (H). Each secured to the seabed via a Ø 4 m suction pile.
17	Disconnectable Turret Buoy (DTB)	1	Ø 11 m X 12.5 m (H) Currently submerged in the water column.
18	Midwater arch, base frame and clump weights	1 each of arch and base frame and 2 clump weights.	One arch: 15 m (L) x 9.3 m (W) x 6.9 m (H), tethered to clump weights via two 54 m tether chains. One base frame (21.8 m (L) x 4.8 m (W) x 3.5 m (H), secured to the seabed via two Ø 4 m suction cans. Two clump weights: Ø 2.9 m x 2.5 m (H), gravity based.
19	84” Mooring piles	9	Ø 2.134 m x 48 m (H)
20	Mooring lines (mooring legs)	9	1.46 km each in length

Figure 2-4: Photograph showing bundled umbilical jumpers.

2.2.1 Wells

The Ettrick development comprises seven production wells: P1 to P7, and two WI wells: referred to as I2 and I5.

The Blackbird development comprises two production wells: PB1 and PB2, and one WI well: IB1. A suspended appraisal well at the Blackbird field will also be abandoned as part of this workscope.

The 13 wells to be decommissioned each have a wellhead structure associated with them. In addition the 12 active wells (excludes the Blackbird appraisal well) each have a Xmas tree and associated control modules that will require to be decommissioned.

2.2.2 Riser and Dynamic Umbilicals

In total five risers (two production, one WI, one gas lift and one gas export) and three dynamic umbilicals (one to each of the manifolds and one to the SSIV on the gas export pipeline) connected the FPSO to the subsea infrastructure (Table 2-1) via a Disconnectable Turret Buoy (DTB). The risers range in length from 0.21 km to 0.27 km and the dynamic umbilicals range in length from 0.21 km to 0.34 km. Following FPSO sail away the risers and dynamic umbilicals are still connected to the DTB which is currently submerged in the water column (see Section 2.3.2.).

2.2.3 Production Flowlines

The FPSO was connected to the EDCM via two 1.65 km trenched production flowlines (PL2443 and PL2444). This manifold is also connected to the Blackbird manifold via a 5.8 km trenched production flowline (PL2800). The manifolds are connected to the production wells via a series of spools laid on the seabed with a total combined length of 0.46 km (Figure 2-1, Figure 2-2).

2.2.4 Water Injection Flowlines

The FPSO was connected to the EDCM via a 1.65 km trenched WI flowline (PL2446). From this manifold a trenched 4.16 km WI flowline (PL2446JI2) connects to one of the Ettrick WI wells (I2) and a 6.7 km trenched WI flowline (PL2448) connects to the Blackbird WI well. Surface laid spools with a total length of 0.04 km connect the EDCM to the second Ettrick WI well (I5) (PL2446JI5).

2.2.5 Gas Lift Flowlines

The FPSO was connected to the EDCM via a 1.63 km trenched gas lift flowline. This manifold is also connected to the Blackbird manifold via a 5.8 km trenched gas lift flowline (PL2800). The manifolds are connected to the production wells via a series of gas lift spools laid on the seabed with a total combined length of 0.46 km.

2.2.6 Gas Export Flowlines

The FPSO was connected to the SAGE pipeline via a 6.17 km trenched gas export flowline. The gas export pipeline also comprises a *c.* 0.25 km spool, an SSIV and a PLEM. The PLEM will remain in operation following E&B decommissioning, as it will be utilised for the GEAD tie-in to the SAGE pipeline.

2.2.7 Umbilical Lines

The FPSO was connected to the EDCM via a 1.64 km trenched umbilical (PLU2447) and is connected to the Blackbird manifold via a 7.74 km trenched umbilical (PLU2802). At the Ettrick field a 4.14 km trenched umbilical connects to the I2 WI well (PLU2447JI2) and a 0.03 km surface laid umbilical jumper connects the EDCM to the I5 WI well.

A 2.04 km trenched umbilical connects the Blackbird manifold to the Blackbird WI well (PLU2920).

A 0.46 km trenched umbilical connected the FPSO to the gas export SSIV.

Thirteen surface laid umbilical jumper bundles, containing electrical cables and chemical flowlines as described connect the manifolds to the wells and have a total combined length of *c.* 0.94 km.

2.2.8 Other Structures

Table 2-1 identifies the other structures associated with the E&B fields. These comprise two manifolds, an SSIV, four SDUs, two valve skids, a pigging skid, and a PLEM on the gas export line. Though as discussed the PLEM will not be decommissioned and therefore is not listed in Table 2-1.

In addition, a number of support structures associated with the risers and dynamic umbilicals are located within the DTB 500 m exclusion zone, including a midwater arch held on location via two clump weights and tether chains, three riser base structures and two riser hold back structures.

As identified in Table 2-1 some of these structures are secured on location using piles whilst others are gravity based.

2.2.9 FPSO Moorings

Prior to sail away the FPSO was held on station via nine mooring chains each with a length of 1.46 km. Each mooring line is attached to an anchor pile. The mooring lines were attached to the FPSO at the DTB and currently remain connected to the DTB at one end and the anchor piles at the other (see Section 2.3.2.).

2.2.10 Protective Structures

Rockcover, mattresses and polypropylene grout bags have been used for protection at the E&B developments.

Table 2-2 summarises the quantities of each associated with the Ettrick and gas export infrastructure and the Blackbird infrastructure. The Decommissioning Programmes identify those trenched and buried pipelines and umbilicals that have areas of rock cover along them. The mattresses and polypropylene grout bags are primarily associated with protection at the trench transitions and protection and support of the spools.

Table 2-2: Protective structures used at the Ettrick and Blackbird Developments.

Structure	Ettrick and gas export line	Blackbird	Total
Rockcover (Te)	32,627	42,750	75,377
Mattresses (number of 4.6 Te mattresses)	209	192	401
Grout bags (number of 25 kg bags)	2,400	2,600	5,000

2.3 Activities to Date

2.3.1 Flushing and Purging of the Topsides and Subsea Infrastructure

Following suspension of production in June 2016 preparatory works, including flushing and pigging of the topsides and flowlines, were carried out in order to clean the infrastructure of as much residual oil and chemicals as possible prior to the disconnection of the flowlines from the wells and the Aoka Mizu FPSO. The pigging and flushing fluids, including those applied subsea from a Dive Support Vessel (DSV) were routed into the slops tanks then through the produced water treatment system prior to discharge. The discharges were managed and monitored following the same process and procedures as the normal produced water batch discharge. These activities were permitted under the existing production permits (PRA/109). The E&B flowlines currently contain treated seawater and minimal quantities of residual hydrocarbons which remained in the flowlines post pigging and flushing. The treated seawater provides some degree of protection to ensure the pipelines are of suitable integrity for recovery as part of full field decommissioning. In addition, the flowlines are currently capped to prevent wildlife ingress.

2.3.2 Disconnection of the Disconnectable Turret Buoy

The risers, dynamic umbilicals and mooring system were connected to the Aoka Mizu via a DTB system. Following flushing and purging of the topsides the FPSO was separated from the DTB which remains submerged in the water column following FPSO sail away. The risers and mooring system currently remain *in situ* hung off the DTB which is resting at a neutrally buoyant depth of approximately 45 m.

2.3.3 Recovery of Section of Gas Export Pipeline and Sections of Rigid Spools

With approval from BEIS, Nexen has recovered a section of the gas export pipeline (*c*. 15 m) following disconnection from the Gas Export PLEM. In addition short sections (2-3 m) of each of the rigid production, gas lift and water injection spools connecting to the wells were removed at each Xmas tree in order to allow a 1 m clearance around each Xmas tree to allow rig access for subsequent Plug and Abandonment (P&A) activities.

The environmental impact associated with the recovered items to date have previously been assessed (PLA/317). However in order to assess the cumulative impact, this EIA assesses the impact of the decommissioning of all the subsea infrastructure including the pipeline and spool sections that have already been recovered.

2.4 Schedule of Activities

Nexen propose to P&A and decommission the E&B fields in four phases/scopes:

- Phase 1: Subsea scope 1 which includes recovery of the DTB, risers, dynamic umbilicals, MWA and moorings;
- Phase 2: Well P&A;
- Phase 3: Subsea scope 2 which includes recovery of manifolds, SSIV, SDUs, jumpers, transition ends and exposed sections of pipelines and umbilicals. Grout bags and mattresses will also be recovered during this phase; and
- Phase 4: Post decommissioning survey.

These phases will be carried out based on the indicative schedule shown in Figure 2-5.

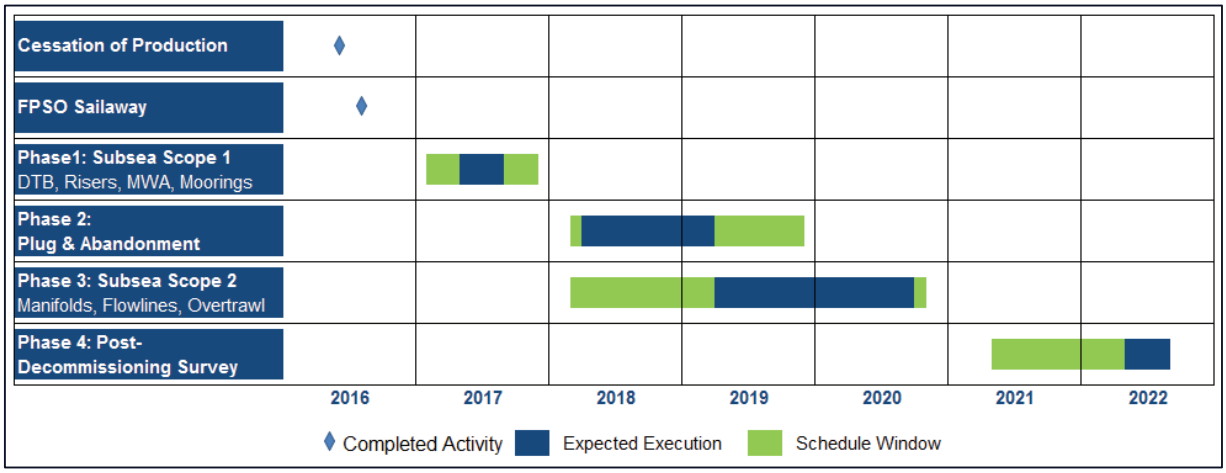

Figure 2-5: Indicative schedule of proposed activities.

2.5 Fate of the Ettrick and Blackbird Infrastructure

OSPAR decision 98/3 as interpreted in DECC's guidance notes does not leave Nexen grounds to seek derogation for the subsea installations such that the wellheads, Xmas trees and associated control modules, the manifolds, SSIV, SDMs, skids, mid water arch, riser base and hold back structures etc. must be recovered. In addition the DTB, risers, dynamic umbilicals and surface laid jumpers and spools will also be recovered. Mattresses and grout bags will be recovered where technically feasible to do so.

The drill cuttings piles are considered to be small in footprint and height and are widely dispersed such that they fall below the OSPAR 2006/5 thresholds. As a result they will be left undisturbed and therefore decommissioned *in situ*.

In line with BEIS guidance notes (DECC, 2011) Nexen propose to sever all piles below the natural seabed level to such a depth as to ensure that any remains are unlikely to become uncovered. The severed top sections will be recovered to shore for recycling.

DECC's guidance notes recognise that removing pipelines buried to a sufficient depth may not be the preferred decommissioning option. They provide for a case by case consideration of pipeline decommissioning alternatives on the basis of a CA. Nexen's Comparative Assessment Report (Nexen, 2014) submitted with this EIA in support of the draft Decommissioning Programmes provides full details of the CA carried out for the decommissioning of the pipelines and umbilicals. A summary of the outcome of the CA is provided here.

2.5.1 Comparative Assessment

As part of the CA a number of decommissioning options were considered for each of the trenched and buried pipelines and umbilicals:

1) Leave in place and rock cover transition ends and exposed sections along the pipeline;
2) Rock cover transition ends and cut and remove exposed pipeline sections;
3a) Bury transition ends and rock cover exposed sections;
3b) Cut and remove all exposed sections in trench and allow trench to backfill naturally; and
4) Complete recovery of all buried flowlines and umbilicals.

Note: transition end refers to that end section of the pipeline exiting the trench.

Each option was scored against safety, environmental impact, technical feasibility, societal impact, reputation, ongoing liability and economics and quantified at five levels of consequence: minor, serious, major, critical and catastrophic. A confidence ranking for each rating was also assigned before a weighted assessment was carried out of the results.

The CA favoured Options 2 and 3a for the different flowlines and umbilicals. Table 2-3 identifies the optimal approach for each flowline/umbilical and a summary justification for the chosen option.

Table 2-3: Outcome from the Comparative Assessment.

Line No/ CA outcome	Justification
PL2443 Option 2/3a	Line is trenched and buried, with an additional 9,921 te of rock cover and is stable with no snagging hazards. At the EDCM end of flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. In this case, rock will be placed as per Option 2.
PL2444 Option 2	Line is trenched and buried, with an additional 8,261 te of rock cover and is stable with no snagging hazards. At both ends of the flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. Rock will be placed as per Option 2.
PL2445 Option 2	Line is trenched and buried, with an additional 3,689 te of rock cover and is stable with no snagging hazards. At both ends of the flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. Rock will be placed as per Option 2.
PL2446 Option 2	Line is trenched and buried, with an additional 221 te of rock cover and is stable with no snagging hazards. At both ends of the flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. Rock will be placed as per Option 2.
PL2446JI2 Option 3a	Line is trenched and buried, with an additional 656 te of rock cover and is stable with no snagging hazards. The transition sections at either end of the flowline will be dredged and buried to a depth of no less than 0.6 m.
PLU2447 Option 3a	Umbilical is trenched and buried, with an additional 52 te of rock cover and is stable with no snagging hazards. The transition sections at either end of the flowline will be dredged and buried to a depth of no less than 0.6 m.
PLU2447JI2 Option 3a	Umbilical is trenched and buried and is stable with no snagging hazards. The transition sections at either end of the flowline will be dredged and buried to a depth of no less than 0.6 m.
PL2448 Option 2/3a	Line is trenched and buried, with an additional 9,827 te of rock cover on the SSIV-PLEM flowline. The line is stable with no snagging hazards. At the PLEM end of the main flowline, rock has been placed over the surface laid flowline, eliminating Option 3a. Rock will be placed as per Option 2 in this location. The three other transition sections will be dredged and buried to a depth of no less than 0.6 m.
PLU2449 Option 3a	Umbilical is trenched and buried and is stable with no snagging hazards. The transition sections at either end of the flowline will be dredged and buried to a depth of no less than 0.6 m.
PL2799 Option 2	Umbilical is trenched and buried, with an additional 16,404 te of rock cover and is stable with no snagging hazards. At both ends of the flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. Rock will be placed as per Option 2.
PL2800 Option 2	Line is trenched and buried, with an additional 10,885 te of rock cover and is stable with no snagging hazards. At both ends of the flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. Rock will be placed as per Option 2.
PLU2802 Option 2/3a	Umbilical is trenched and buried, with small area of rock covering ~70m (585 te) and is stable with no snagging hazards. At the Blackbird manifold end of the umbilical, rock has been placed over the surface laid section, eliminating Option 3a. Rock will be placed as per Option 2 in this location. The transition section at the FPSO will be dredged and buried to a depth of no less than 0.6 m.
PL2919 Option 2	Line is trenched and buried, with an additional 13,670 te of rock cover and is stable with no snagging hazards. At both ends of the flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. Rock will be placed as per Option 2.
PLU2920 Option 2	Umbilical is trenched and buried, with two small areas of rock totalling 1,206 te and t is stable with no snagging hazards. At both ends of the flowline, rock has been placed up to the end of the transition point, eliminating Option 3a. Rock will be placed as per Option 2.

2.6 Decommissioning Activities

2.6.1 Well Abandonment / Shut-in

The 13 wells (nine production wells, three WI wells, and one appraisal well) will be P&A in accordance with Oil & Gas guidelines for the abandonment of wells (DECC Issue 5, July 2015) and Nexen standards. Nexen will mobilise a semi-submersible drilling rig to carry out the P&A activities.

The P&A activities are expected to include:

- Installation of cement plugs in the wells to provide the required isolation for all porous, permeable and hydrocarbon bearing intervals;
- Cutting and removal of casing; and
- Removal of the wellheads and Xmas trees.

Following cementing, the surface and conductor casing will be cut approximately 3 m below the seabed and the Xmas tree will be recovered together with the cut section of the casing.

Environmental permit applications for the P&A of the wells will be submitted under a Well Intervention MAT (Master Application Template) via the PETS (Portal Environmental Tracking System). Environmental permit applications to be submitted will include a Consent to Locate (CtL) application to locate the drilling rig, a chemical permit application detailing the chemicals to be used and discharged and a Marine Licence for the removal of the wellheads and Xmas trees

2.6.2 Subsea Deconstruction

The subsea infrastructure will be decommissioned in a safe condition. Further details of the activities discussed in the following sections will be provided in the Marine Licence permit applications to be submitted to BEIS prior to commencement of the offshore decommissioning campaign.

2.6.2.1 Flowlines, umbilicals and jumpers

Trenched and buried flowlines and umbilicals

As discussed in Section 2.5.1 the buried flowlines and umbilicals will largely be decommissioned *in situ*. The non-trenched flowline and umbilical ends will be severed and recovered to shore for recycling. The remaining exposed ends and any exposed sections along the flowlines or umbilicals will either be buried or rock covered. Section 2.6.3 captures the rock cover requirements identified at the time of writing (Note: Nexen propose to carry out a pipeline route survey in 2017 to determine if any further areas of concern regarding depth of burial of the flowlines or umbilicals have arisen).

Surface laid spools and jumpers

All surface laid spools and jumpers will be recovered and return to shore for recycling.

2.6.2.2 Subsea Structures

The wellheads, Xmas trees and associated control modules, manifolds, SSIV, SDUs, valve and pigging skids, the DTB, mid water arch and associated base frame and clump

weights will all be recovered and returned to shore for recycling. The DTB will be returned to its owner, Bluewater, for future redeployment or recycling.

The piles associated with the manifolds and mooring lines will be severed with the top sections being removed to a depth of 3 m below the seabed. The suction cans associated with the riser bases and the mid water arch base frame will be removed by reverse installation.

Rockcover will remain *in situ* following decommissioning, whilst Nexen propose to recover all mattresses and grout bags that are not covered by rock.

2.6.2.3 Mooring lines and anchors

The FPSO is moored via 9 mooring lines each with a length of *circa* 1.5 km. Each mooring line is attached to an anchor pile which will be cut *circa* 3 m below the surface. The mooring lines will be recovered to shore for reuse/recycling. Any depressions created during mooring line recovery will be left in an overtrawlable condition.

2.6.2.4 Monitoring for LSA / NORM

The presence of LSA / NORM (Low Specific Activity / Naturally Occurring Radioactive Material) deposits is a recognised phenomenon in the oil and gas industry. The production and WI systems are known to be contaminated with NORM. As a result, trained personnel competent in the use of radioactivity detection monitors will be onboard the vessels used to recover the subsea infrastructure and will monitor all items as they come on board for the presence of LSA / NORM.

In the event that one or more recovered items is found to be contaminated, the items will be contained and sealed and shipped to shore for decontamination by a Nexen approved contractor under Nexen's and the contractor's management systems.

2.6.3 Rock Cover Requirements

Rock cover will be required on the exposed pipeline ends and on a number of sections along the pipeline where the Depth of Cover (DoC) or Depth of Line (DoL) are not considered adequate (Figure 2-6).

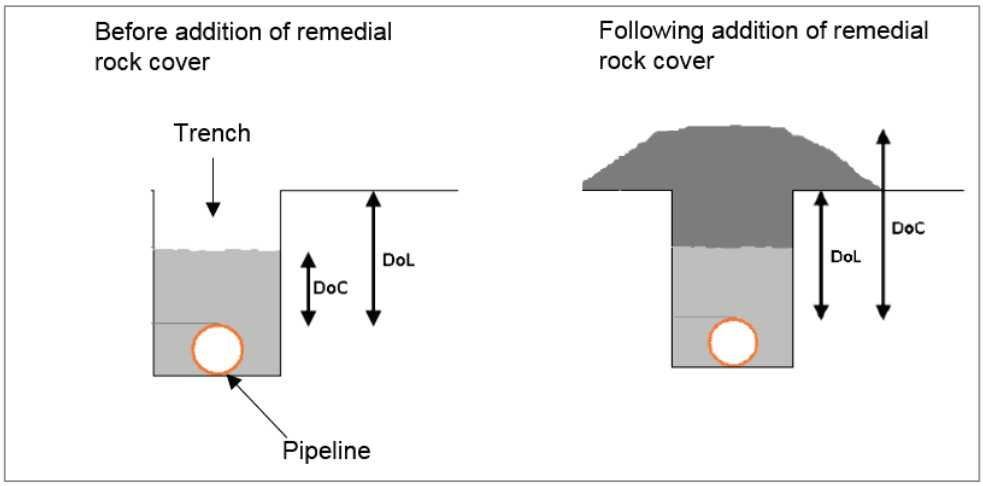

Figure 2-6: Schematic illustrating meaning of DoC and DoL.

Estimated additional rock cover requirements are provided in Table 2-4. These estimates are based on pipeline route survey data from 2010 and 2012 (Fugro, 2010 and Fugro, 2012) and are currently considered indicative of the requirements. Prior to commencement of rock cover activities Nexen will carry out further pipeline and umbilical route surveys to determine if there are any other areas where the DoC or DoL may be of concern. The results from these surveys will be discussed with BEIS and the Statutory Consultees to identify the optimal approach to addressing them. For the purpose of this EIA, the anticipated rock cover requirements as determined from the earlier surveys are assessed. Across the pipelines and umbilicals associated with the E&B fields it is estimated from these surveys that up to 10,914 te of rock cover will be required to cover a total of 1,795 m of pipelines/umbilicals impacting on a corridor width of 7 m (resulting in a height of rock of 1 m). This equates to an increase of 14.5 % of the rock already in place across the two fields (75,377t).

The rock quantities provided are considered to be conservative at the time of writing, and Nexen will endeavour to minimise any additional rock placed in the field, whilst placing the safety of other users of the sea (i.e. fishermen) above all other considerations.

Table 2-4: Estimated rock cover requirements.

Pipeline	Description
PL2443 Ettrick production flowline P1	Currently rock placed along the majority of flowline. 2010 survey data indicates average DoC of 1.08 m. Marginal DoC around KP 0.9 possibly requiring rock cover. Estimated approximately 130 m of pipeline will require rock cover.
PL2444 Ettrick production flowline P2	Currently rock placed along majority of flowline. 2010 survey data indicates average DoC of 1.04 m. Marginal DoC around KP1.0 and KP0.6 possibly requiring additional rock cover. Estimated approximately 65 m of pipeline will require additional rock cover.
PL2446 Ettrick WI flowline	2012 survey data shows an average DoC of 0.80 m. Main areas of DoC concern at KP0.5, KP1.0 and KP1.2, but DoC appears to be increasing. Particular concern at KP1.1. Estimated approximately 500 m of pipeline will require additional rock cover.
PL2446I2 Ettrick WI flowline	Combined DoC and DoL survey data indicates an improving profile, with an area of concern around KP1.7 and KP 3.5. Limited survey data for 1 km of route. Estimated approximately 100 m of pipeline will require additional rock cover.
PLU2447 Ettrick main umbilical	Combined DoC and DoL survey data indicates areas of concern at KP0.5, and marginal concern at KP0.7 and KP1.1. Estimated approximately 500 m of pipeline will require additional rock cover.
PL2448 Gas export flowline	2012 survey data shows an average depth of cover of 0.74m, with marginal concerns over much of the route, particularly KP2.5 and KP4.0. Estimated approximately 500 m of pipeline will require additional rock cover.

2.6.4 Vessel Requirements

A range of specialist and support vessels will be required at various times and for various durations to support the proposed decommissioning workscopes. In order to complete the P&A activities the drilling rig is anticipated to be on station at the E&B fields for around 1 year. Whilst the drilling rig is on location a standby vessel will be present at all times and a supply vessel will support the rig. The number of days estimated is conservative and allows for delays such as waiting on weather.

In addition, the decommissioning activities will require a number of specialist and support vessels including Dive Support Vessels (DSVs), Construction Support Vessels (CSVs), Anchor Handing Vessels (AHV) and rock cover vessels. These vessels will likely hold their position using dynamic positioning (DP).

At the time of writing, specific vessels have not yet been identified, however, the types of vessel required are well known and performance characteristics for typical vessels have been assumed for the purposes of estimating energy consumption and emissions to air. By estimating the fuel use based on generic vessel types (Institute of Petroleum Guidelines (IoP), 2000 and industry experience) and the likely duration of the work programme for each vessel, estimates of fuel consumption can be made. Estimates are shown in Table 2-5.

Table 2-5: Anticipated vessel requirements and fuel usage.

Vessel		Fuel consumption rate (Te/d)	Fuel usage (Te)
Type	Duration (days)		
Phase 1: Subsea Scope 1			
DSV	15	17.5	263
CSV	25	25[1]	625
AHV	30	21	630
Phase 2: Well P&A			
Semi-submersible rig	340	9[2]	3,060
AHVs	180	21	3,780
Standby vessel	340	4[2]	1,360
Supply vessel in transit and on location assuming 50% time in transit and 50% on location)	340	10 (transit) 1.5 (on location)	1,955
Phase 3 Subsea Scope 2			
DSV	30	17.5	525
CSV	50	25[1]	1,250
Rock cover vessel	15	15	225
Guard vessel	700	4[2]	2,800
Trawler	5	4[2]	20
Total			16,493

1. IoP guidelines do not always have exact equivalent vessel: e.g. for the CSV – figures for a Multipurpose Support Vessel (MSV) were used.
2. Based on Industry experience.

2.6.5 Fate After Leaving Field

Recovered subsea equipment will be returned to quayside for initial laydown. It will be transferred to an area designated for cleaning and dismantling. The site will have appropriate environmental and other operating licences in order to carry out this work and will be managed within Nexen's contractor assurance processes. The equipment will be separated into components that are suitable for reuse or for recycling through appropriate waste recycling chains.

2.6.6 Survey and Monitoring Programme

A post decommissioning site survey will be carried out approximately 2 years after completion of decommissioning. Surveys will be undertaken along all pipeline routes and at all sites where structures have been removed. Any significant debris will be recovered for onshore recycling or disposal. Independent verification of the seabed state will be obtained by trawling the trenched pipeline areas and a statement of clearance will be provided to all relevant governmental and non-governmental organisations.

A post decommissioning environmental seabed survey, centred on the site of the wellheads and installations will be carried out. The objective of the survey is to identify any chemical or physical disturbances to the seabed following decommissioning. The survey reports will be submitted to BEIS and a post monitoring survey regime will be agreed.

3.0 ENVIRONMENTAL DESCRIPTION

This section describes the current nature and status of the environment at the Ettrick and Blackbird Fields. An understanding of the environment is required in order to identify the potential environmental impact and to provide a basis for assessing the potential interactions of the decommissioning / mothballing activities with the environment.

The fields lie predominantly in Blocks 20/2a and 20/3a in the Outer Moray Firth Area *c.* 80 km from shore in 110 m water depth Figure 1-1. The Blackbird field also extends into Block 20/3f.

Statutory EIAs and the associated Environmental Statements were produced for the Ettrick Field Development (Nexen, 2005) and the Blackbird Field Development (Nexen, 2010). In support of these two developments, a number of environmental surveys were undertaken (Figure 3-1). This section has been prepared with reference to available literature, expertise, previous experience and the site specific survey data.

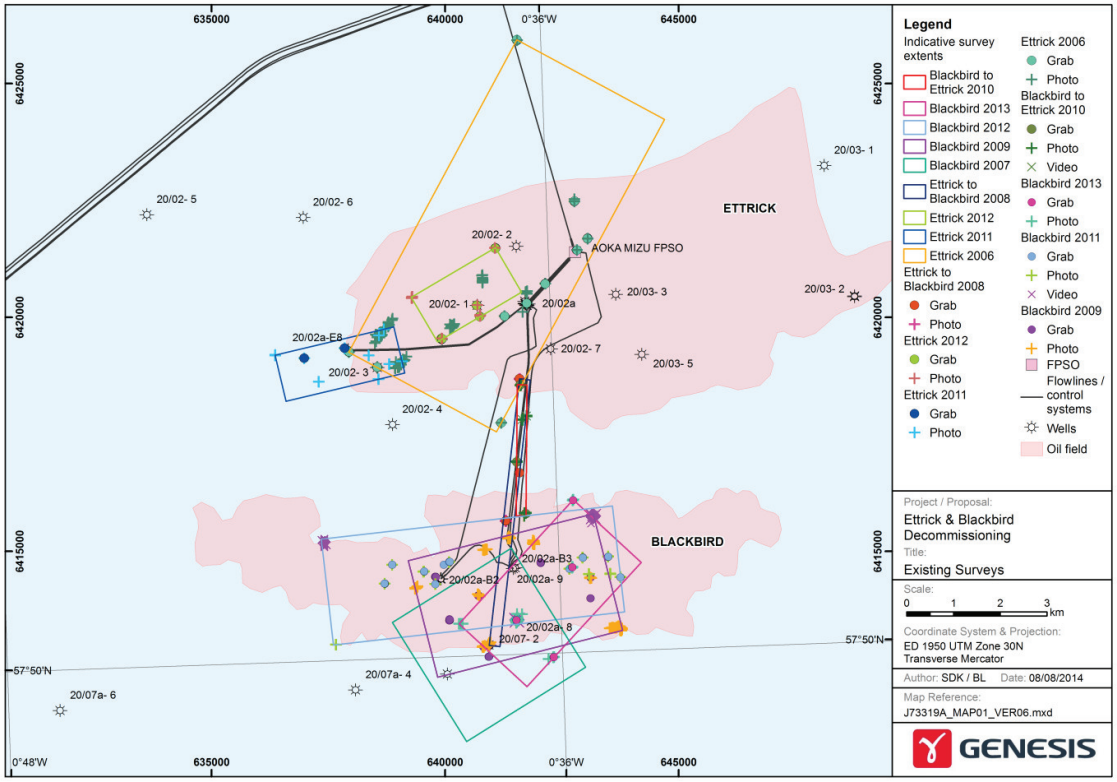

Figure 3-1: Location of Ettrick and Blackbird fields and the surveys undertaken in the area.

3.1 Physical Environment

3.1.1 Bathymetry

Knowledge of the bathymetry in the area will help to understand the movement of sediments and possible contaminants associated with the sediment. The seabed in the vicinity of E&B subsea infrastructure is relatively flat at depths of between 90 and 130 m.

3.1.2 Water Masses, Currents and Tidal Streams

The major water masses in the North Sea can be classified as Atlantic water, Scottish coastal water, Northern North Sea (NNS) water, Norwegian water, Central North Sea (CNS) water, Southern North Sea (SNS) water, Jutland water and Channel water (Turrell, 1992). The Blackbird Development is located in the area influenced by the Northern North Sea water mass.

Circulation in the North Sea is driven by a combination of winds, tidal forcing and topographically-steered inflows. The predominant regional current in the CNS originates from the vertically well-mixed coastal water and Atlantic water inflow of the Fair Isle/Dooley current (Figure 3-2), which flows around the north of the Orkney Islands and into the North Sea (BMT Cordah, 1998) (NSTF, 1993). The background, or residual, flow in the CNS (associated with North Sea circulation patterns) is typically 0.2 m/s towards the south (DTI, 2001).

The general pattern of water movement in the North Sea may be strongly influenced by short to medium term weather conditions, resulting in considerable seasonal and annual variability (DTI, 2004).

The water currents in the E&B development area are predominantly driven by the Fair Isle Current and the Dooley Current moving in an anticlockwise direction (DTI, 2001). The tidal currents range between 0.39 m/s and 0.5 m/s with surge and wind driven currents being greater (BODC (British Oceanographic Data Centre), 1998).

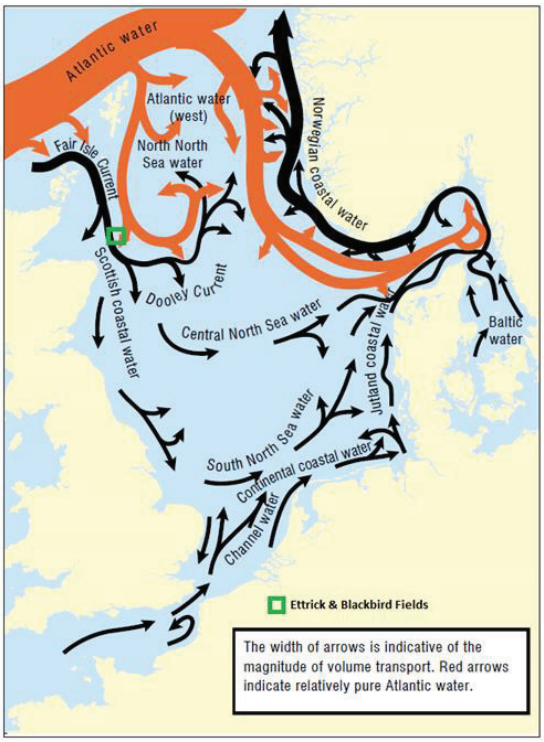

Figure 3-2: Current Circulations in the North Sea (after Turrell, 1992).

3.1.3 Sea Temperature and Salinity

The temperature and salinity of sea water affects the fate of discharges and releases in the marine environment. Sea surface temperatures in the northeast Atlantic and UK coastal waters have been rising since the 1980s, most rapidly in the Southern North Sea (SNS) and the English Channel.

Fluctuations in salinity are largely caused by the addition or removal of fresh water to/from the sea through natural processes. The salinity of seawater around an installation has a direct influence on the initial dilution of aqueous effluents. As salinity decreases the solubility of effluents generally increases. The temperature and salinity in the vicinity of the E&B fields are shown in Table 3-1.

Table 3-1: Seawater temperature and salinity.

Temperature (°C)				Salinity (ppt)
Summer		Winter		
Surface	Bottom	Surface	Bottom	
13	9	6.5	7	35

3.1.4 Sediments

Understanding the type of sediment in the area will assist in understanding the movement of the sediment and consequently the implications of leaving infrastructure in place. In addition the plant and animal species found in an area are often closely linked to the sediment type, in particular benthic species.

The sediment in the area of the Ettrick subsea infrastructure is sand and muddy sand (Fugro, 2002) and the sediment in the area of the Blackbird development is predominantly fine silty sand to very fine sands (Gardline, 2010a). An observed increase in fines close to the PB1 well location was attributed to the presence of fine drilling muds associated with drilling activities.

Pockmarks have been seen in the Blackbird area, associated with the near surface geology of the Witch Ground Formations (Gardline, 2010a). In the proximity of the development itself a few small seabed depressions and one large depression were identified, all of which have been attributed to scour around boulders. The detected pockmarks showed no evidence of gas leakage or Methane-Derived Authigenic Carbonate (MDAC) structures (MDAC is discussed further in Section 3.2.1.).

Chemical analysis on sediment samples from the Blackbird location and pipeline route showed total organic matter (TOM), total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAH), alkanes and barium values to generally be within typical background levels for the North Sea. However the levels of barium, alkanes, mercury, iron, lead and zinc were found to be above background levels in the sample taken close to the PB1 well, these elevated levels being attributed to historical drilling contaminants. The sediments in the Ettrick area showed that concentrations of the majority of the heavy metals were within published UKOOA (currently Oil and Gas UK) mean concentrations for the CNS. The exceptions (barium, iron and lead) were moderately above these published values. The total hydrocarbon concentrations and concentrations of n-alkanes and PAHs were considered to represent background levels for the CNS.

3.1.5 Water Quality

Chemical analysis was not available for the water in the vicinity of the Ettrick or the Blackbird development; however, given the water mixing resulting from currents in the area and the careful regulation of discharges it is anticipated that the water quality in the vicinity of the E&B developments will be typical of the CNS.

3.2 Environmental Legislation Protecting Habitats and Species

The EU Habitats Directive (92/43/EEC) and the EU Birds Directive (79/409/EEC) are the main driving forces for safeguarding biodiversity in Europe.

Through the establishment of a network of protected sites these directives provide for the protection of animal and plant species of European importance and the habitats that support them.

The EU Habitats Directive and the EU Birds Directive have been enacted in the UK by the following legislation:

- The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended) transpose the Habitats and Birds Directives into UK law. They apply to land and to territorial waters out to 12 nautical miles from the coast and have been subsequently amended several times.
- The Conservation of Habitats and Species Regulations 2010: The Conservation of Habitats and Species Regulations 2010 consolidate all the various amendments made to the Conservation (Natural Habitats, &c.) Regulations 1994 in respect of England and Wales. In Scotland, the Habitats and Birds Directives are transposed through a combination of the Habitats Regulations 2010 (in relation to reserved matters) and the 1994 Regulations.
- The Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (as amended 2009 and 2010): These regulations are the principal means by which the Birds and Habitats Directives are transposed in the UK offshore marine area (i.e. outside the 12 nm territorial limit) and in English and Welsh territorial waters.
- The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended 2007): These regulations apply the Habitats Directive and the Wild Birds Directive in relation to oil and gas plans or projects wholly or partly on the United Kingdom Continental Shelf and adjacent waters outside territorial waters (i.e. outside the 12 nm territorial zone).
- The Habitats Directive lists those habitats and species (Annex I and II respectively) whose conservation requires the designation of special areas of interest. These habitats and species are to be protected by the creation of a series of 'Special Areas of Conservation' (SACs), and by various other safeguard measures such as Sites of Community Importance (SCIs) for particular species (Table 3-2).
- The Birds Directive requires member states to nominate sites as Special Protection Areas (SPAs). Together with adopted SACs, the SPA network form the 'Natura 2000' network of protected areas in the European Union.

Table 3-2: Definition of UK SAC/SCI Sites.

Site	Description
SAC	SACs are sites that have been adopted by the European Commission (EC) and formally designated by the government of each country in whose territory that site lies.
Site of Community Importance (SCIs)	SCIs are sites that have been adopted by the EC but not yet formally designated by the government of each country.
Candidate SAC (cSAC)	Candidate SACs (cSACs) are sites that have been submitted to the EC and not formally adopted.
Possible SAC (pSAC)	Possible SACs (pSACs) are sites that have been formally advised to UK Government, but not yet submitted to the EC.
Draft SAC (dSAC)	Draft SACs (dSACs) are areas that have been formally advised to UK government but not yet approved by it.

BEIS considers all types of SAC in the same way, as if they have already been designated. Therefore, as with SACs, any activity likely to have a significant effect on the site of a cSAC, pSAC or dSAC must be appropriately assessed.

It must be demonstrated that activities will not significantly disturb a European Protected Species (EPS) in a way that will affect either alone or in combination with other plans and projects;

- the ability of the species to survive, breed, rear or nurture its young or affect its hibernating or migration patterns (termed the injury offence), or
- the local distribution or abundance of any protected species (termed the disturbance offence).

3.2.1 Habitats

Of the habitat types listed in the Habitats Directive (Annex I) requiring protection, four occur or potentially occur in the UK offshore area (JNCC, 2012);

- sandbanks which are slightly covered by seawater at all times;
- reefs;
  - bedrock reefs; made from continuous outcroppings of bedrock which may be of various topographical shape (e.g. pinnacles and offshore banks);
  - stony reefs; aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces; and
  - biogenic reefs; formed by cold water corals (e.g. *Lophelia pertusa*) and the polychaete worm *Sabellaria spinulosa;*
- submarine structures made by leaking gases; and
- submerged or partially submerged sea caves.

The nearest SCIs to E&B developments are the Braemar Pockmarks and the Scanner Pockmark SACs which lie *c*. 150 km east northeast and 93 km northeast of Block 20/3 respectively (Figure 3-3).

The nearest onshore protected site is the Buchan Ness to Collieston Coast SPA, which is *c.*70 km southwest of the developments (Figure 3-3).

Reef habitats are listed within Annex I of the Habitats directive. *Lophelia pertusa*, a cold water coral that forms biogenic reefs, is therefore considered a protected species under the Habitats Directive. Surveys carried out in the area of the E&B developments have not identified the presence of any *L. pertusa*; however, it is known to exist on offshore installations as marine growth (OGUK, 2013). Only naturally growing reefs are protected as opposed to the colonies found attached to offshore subsea structures; the colonies growing on these structures are not classed as 'habitat' and can therefore be removed. *L. pertusa* is also listed under the Convention on International Trade in Endangered Species (CITES). Current guidance from the Department for Environment, Food and Rural Affairs (DEFRA) is that CITES requirements are disapplied for *L. pertusa* attached to manmade structures, provided that it is disposed of (OGUK, 2013).

'Submarine structures made by leaking gases' are defined by the Habitats Directive as comprising MDAC that forms rock-like slabs, pavements and pillars created through a process of precipitation where the carbonate cements the sand (Judd, 2001). There were no MDAC features identified in the surveys carried out in the area of the E&B developments.

3.2.2 Scottish Marine Protected Areas

Under the Marine (Scotland) Act and the UK Marine and Coastal Access Act (2009) the Scottish MPA Project led by Marine Scotland in partnership with the SNH, JNCC and others designated 30 Nature Conservation Marine Protected Areas (NCMPAs) in July 2014.

These NCMPAs were chosen based on:

- The contribution of existing protected area analysis;
- Contribution of other area-based measures; and
- Contribution of least damage/more natural locations.

The nearest NCMPA to the E&B developments is Turbot Bank *c.*40 km south of Block 20/2 (Figure 3-3). The Turbot Bank NCMPA is located off the east coast of Scotland, and lies within an area of sandy sediment. It includes part of the shelf bank and mound known as 'Turbot Bank', an area of importance for sandeels where they live buried in the sand for months at a time.

In addition to the designated NCMPAs, four possible MPA (pMPA) search locations remain. These areas will be assessed once SNH have gathered the relevant evidence to support their designation. The nearest pMPA search location to E&B is the Southern Trench pMPA search location located *c.*46 km west of the fields. The search location is shaped around the Southern Trench, a large undersea valley consisting of an area of deep water (~200 m) extending along the south of the outer Moray Firth, *c.*10 km from the coast. The Southern Trench is an example of an enclosed (glacial) seabed basin and is regarded as scientifically important to understand ice sheet drainage patterns in this region.

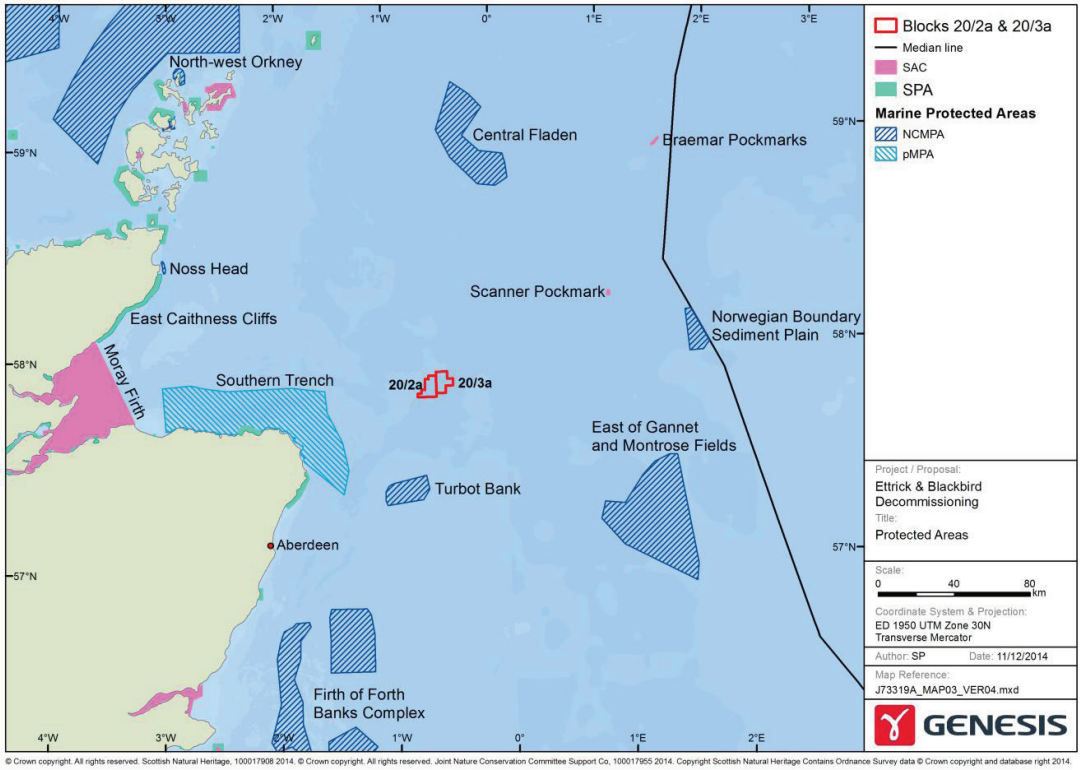

Figure 3-3: Location of the Ettrick and Blackbird fields in relation to areas of conservation.

3.2.3 Species

There is growing interest in the designation of fish species requiring special protection in UK waters with particular focus on large slow growing species such as sharks and rays. The Wildlife and Countryside Act 1981 consolidates and amends existing national legislation to implement the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) and the Birds Directive. The Act makes it an offence to intentionally kill, injure, possess or trade any animal listed in Schedule 5 and to interfere with places used by such animals for shelter or protection. There are twelve Schedule 5 fish species occurring in UK marine and estuarine waters. Of these, those that could potentially occur in the area are the Allis shad (*Alosa alosa*), the twaite shad (*Alosa fallax*), the basking shark (*Cetorhinus maximus*) and the angel shark (*Squatina squatina*). Although present within the North Sea the species listed above are widely dispersed and many are uncommon and are unlikely to be found in particular concentrations within the E&B area.

Four marine mammal species listed under Annex II of the Habitats Directive occur in relatively large numbers in UK offshore waters;

- Grey seal (*Halichorerus grypus*);
- Harbour seal (*Phoca vitulina*);
- Bottlenose dolphin (*Tursiops truncatus*); and
- Harbour porpoise (*Phocoena phocoena*).

The bottlenose dolphin and the harbour porpoise, like all the cetacean species found in UK waters, also have EPS status, along with several other marine mammals found in UK waters.

3.2.4 Priority Marine Features

In addition to the list of features of nature conservation importance, identified as part of the Scottish MPA Project, SNH and JNCC have compiled a separate list of 80 habitats and species, termed Priority Marine Features (PMFs) which are considered to be of particular importance in Scotland's seas. The purpose of this list (currently in draft form) is to guide policy decisions regarding conservation in Scottish waters (JNCC, 2012).

3.3 Marine Flora and Fauna

3.3.1 Plankton

Plankton are drifting organisms that inhabit the pelagic zone of a body of water and include single celled organisms such as bacteria as well as plants (phytoplankton) and animals (zooplankton). Phytoplankton are the primary producers of organic matter in the marine environment and form the basis of marine ecosystem food chains. They are grazed on by zooplankton and larger species such as fish, birds and cetaceans. Therefore, the distribution of plankton directly influences the movement and distribution of other marine species.

The planktonic assemblage in the area of the Blackbird and Ettrick Developments is considered typical of the North Sea. The phytoplankton community in the NNS and CNS is dominated by the dinoflagellate genus *Ceratium* and the diatom genus *Chaetoceros* (Johns & Reid, 2001). The zooplankton communities across the whole North Sea are

broadly similar. The most abundant group is the copepods, which are dominated by *Calanus* species (Johns & Reid, 2001). The larger zooplankton (or megaplankton) of the North Sea include the euphausiids (krill), thaliacea (salps and doliolids), siphonophores and medusae (jellyfish) (DTI, 2004).

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

Plankton are vulnerable to toxic effects of both chemical and hydrocarbon discharges, however, as plankton species commonly have short lifecycles and there tends to be a continual exchange of individuals with the surrounding water they can be expected to recover relatively quickly following an event; for example, discharge of production chemicals to the sea.

3.3.2 Benthos

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

The sampling undertaken in the E&B area showed the benthos to be both rich and relatively abundant with high species richness giving high diversity at all sample locations. The macrofauna found in the area was characteristic of the fine sand substrates of the CNS and any minor variations generally reflected the sediment type of the individual stations (Eleftheriou & Basford, 1989).

The benthic infaunal communities in the E&B area are typical of the CNS with the normal polychaete dominated structure exhibiting high diversity and moderate abundances.

In terms of the individual species, the benthic infaunal community structure demonstrates a great deal of stability over the time the surveys were conducted. No indications of anthropogenic influence were detected apart from at a single station in a single year (close to the PB1 well) and no communities of conservation interest were identified.

Analysis of samples from across the wider nearby Buzzard region, show the E&B samples to be similar to the wider area (Nexen and Genesis, 2014b).

The epifaunal community can be described as relatively depauperate, comprising mainly seapens (*Pennatula phosphorea*) and sparsely distributed megafaunal burrows. The density of the seapens observed was not considered sufficient to explicitly classify the area as ‘seapen and burrowing megafauna communities’ and it is unlikely that this area would be selected to be representative of this habitat Priority Marine Feature (PMF). Over time, the epifaunal communities exhibited a stable structure but the habitats, though stable were unexceptional (Nexen and Genesis, 2014b).

Fauna identified from seabed photography included occasional hagfish (*Myxine glutinosa*), seapens (*Pennatula phosphorea*), possible hydroids, bryozoans, hermit crabs (Paguridae) and possible Norway lobster (*Nephrops norvegicus*) burrows and specimens of *N. norvegicus*.

3.3.3 Fish and Shellfish

At present more than 330 fish species are thought to inhabit the shelf seas of the UKCS (Pinnegar *et al*., 2010). Pelagic species (e.g. herring (*Clupea harengus*), mackerel (*Scomber scombrus*), blue whiting (*Micromesistius poutassou*) and sprat (*Sprattus sprattus*)) are found in mid-water and typically make extensive seasonal movements or migrations. Demersal species (e.g. cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinus*), sandeels (*Ammodytes tobianus*), sole (*Solea solea*) and whiting (*Merlangius merlangus*)) live on or near the seabed and, similar to pelagic species, many are known to passively move (e.g. drifting eggs and larvae) and/or actively migrate (e.g. juveniles and adults) between areas during their lifecycle.

Fish occupying areas in close proximity to offshore oil and gas installations will be exposed to aqueous discharges and may accumulate hydrocarbons and other contaminating chemicals in their body tissues. The most vulnerable stages of the life cycle of fish to general disturbances such as disruption to sediments and oil pollution are the egg and larval stages. Hence recognition of spawning and nursery grounds within a development area is important.

The E&B developments lie in Blocks 20/2 and 20/3. Known fish spawning and nursery grounds in the vicinity of these blocks are shown in Table 3-3. In addition to those species listed in Table 3-3, Ellis *et al*. (2012) list a number of species that use the area as a nursery ground including spurdog (*Squalus acanthias*), spotted ray (*Raja montagui*), herring, cod, ling (*Molva molva*) and hake (*Merluccius merluccius*). Of the species identified, mackerel, Norway pout, cod, whiting, sandeels, blue whiting, herring and ling have been assessed by SNH and JNCC as PMF in Scotland (JNCC, 2012).

Table 3-3: Fish spawning (S) and nursery (N) grounds in Blocks 20/2 and 20/3 (Coull *et al*., 1998).

Species	J	F	M	A	M	J	J	A	S	O	N	D	Nursery
Whiting		S	S	S	S	S							N
Lemon sole				S	S	S	S	S	S				N
Norway pout	S	S*	S*	S									N
Sprat					S*	S*	S	S					N
Nephrops	S	S	S	S*	S*	S*	S	S	S	S	S	S	N
Sandeel	S	S									S	S	N
Haddock													N
Blue whiting													N

**Period of highest levels of spawning*
Note that nursery grounds may be in use throughout the year.

Marine Scotland has registered a 'period of concern' for seismic and drilling activity in the vicinity of Block 20/02 and Block 20/03 from February to June (DECC, 2014a).

3.3.4 Marine Mammals

Marine mammals include cetaceans (whales, dolphins and porpoises), pinnipeds (seals) and mustelids (otters), all of which are susceptible to anthropogenic stresses. They are also affected indirectly by any processes that may affect prey availability.

3.3.4.1 Mustelids

Only freshwater otters are to be found in European waters and hence routine offshore oil and gas activities do not directly affect these mammals. However, noise within the water column or oil washed ashore from extreme oil spills could impact otters. One such effect is hypothermia resulting from the otters' fur being covered in oil and no longer being able to function as a thermal layer.

3.3.4.2 Pinnipeds

Two species of seals live and breed in UK water: grey seals (*Halichoerus grypus*) and harbour (also called common) seals (*Phoca vitulina*). They occur along the Aberdeenshire coast and have haul-out sites in several locations, including at the Sands of Forvie Nature reserve, *c.*90 km west of the E&B developments (SNH, 2009). Both of these seal species are protected under Annex II of the EC Habitats Directive.

Tracking of individual grey seals has shown that they can feed up to several hundred km offshore although most foraging tends to be within *c.*100 km. The foraging range of the harbour seal is typically within 40 – 50 km (SCOS, 2011). Given the distance of the E&B fields from the coast it is unlikely that harbour seals will occur. It is possible that grey seals may forage in the area, however based on observed foraging ranges numbers would be expected to be low.

3.3.4.3 Cetaceans

Sightings of several species of cetacean have been recorded on the European continental shelf. However in many instances within the North Sea recorded sightings are associated with single individuals (Reid *et al*., 2003). Cetacean species sighted just once or in very low numbers in the North Sea include whales (e.g. sei, fin, pygmy sperm, Curvier's beaked, humpbacked and beaked) and dolphins (e.g. short beaked common dolphin, striped dolphin and Risso's dolphin). Killer whales and long finned pilot whales have been sighted in relatively higher numbers in the NNS while large numbers of common bottlenose dolphins are to be found along the coastal regions of the UK (Reid *et al*., 2003).

Harbour porpoise, minke whale, white-beaked dolphin, white-sided dolphin, Risso's dolphin and killer whale have been sighted in the area of Quadrant 20 as shown in Table 3-4 (Reid *et al*., 2003). Data indicate that minke whale, killer whale, bottlenose dolphin, white-sided dolphin and Risso's dolphin occur in relatively low abundance (0.01-0.09 animals/km of survey track) (Evans, 1992). The densities of white-beaked dolphin and harbour porpoise vary from low to high (0.2-0.49 animals/km) throughout the year but appear to be relatively high in the summer months (Evans, 1992).

Table 3-4: Sightings of cetaceans in Quadrant 20 (Reid *et al.*, 2003).

Species	J	F	M	A	M	J	J	A	S	O	N	D
Minke whale						■	■		■			
Killer whale	■	■	■								■	■
Bottlenose dolphin							■	■				
White-beaked dolphin		■				■	■	■	■	■		
White-sided dolphin						■	■	■	■			
Risso's dolphin							■					
Harbour porpoise	■	■			■	■	■	■				

Based on shipboard surveys (SMRU, 2008), estimated densities of minke whales and harbour porpoises within the area of the development and towards the coast are 0.028 and 0.294 animals per km^2 respectively. Estimating densities of white beaked and white sided dolphins separately is more difficult due to their physical similarities.

3.3.5 Seabirds

Seabirds are generally not at risk from routine offshore production operations. However, they may be vulnerable to pollution from less regular offshore activities such as well testing and flaring, when hydrocarbon dropout to the sea surface can occasionally occur, or from discharges such as oil spills.

Birds are vulnerable to oily surface pollution, which can cause direct toxicity through ingestion and hypothermia as a result of the birds' inability to waterproof their feathers. Birds are most vulnerable in the moulting season when they become flightless and spend a large amount of time on the water surface. This significantly increases their vulnerability to oil spills.

Fulmars (*Fulmarus glacialis*), guillemots (*Uria aalge*) and puffins (*Fratercula arctica*) are particularly vulnerable to surface pollutants as they spend the majority of their time on the surface of the water. Herring gull (*Larus argentatus*), kittiwake (*Rissa tridactyla*) and great black-backed gull (*Larus marinus*) are less vulnerable as they spend a larger proportion of their time flying and therefore less time on the sea surface (Stone *et al.*, 1995). After the breeding season ends in June, large numbers of moulting auks (guillemots, razorbills (*Alca torda*) and puffins) disperse widely away from their coastal colonies and into offshore waters. At this time these high numbers of birds are particularly vulnerable to oil pollution.

Seabird vulnerability to oil pollution is measured using the JNCC Offshore Vulnerability Index (OVI). The OVI for seabirds within each offshore licence block changes throughout the year. This is due to seasonal fluctuations in the species and number of birds present in an area. Table 3-5 details the OVI within the vicinity of the area. The overall seabird vulnerability of the area is high.

JNCC has registered a 'period of concern' from July to September in Block 20/2 and July to October in Block 20/3 due to drilling activities (DECC, 2014a).

Table 3-5: Seabird vulnerability in vicinity of the Ettrick and Blackbird fields (JNCC, 1999).

Block	J	F	M	A	M	J	J	A	S	O	N	D	Overall
14/26	4	2	3	3	4	3	1	1	1	4	3	3	2
14/27	4	2	3	3	4	3	1	1	1	4	3	3	2
14/28	4	2	3	3	4	3	1	1	1	2	3	3	2
20/1	4	2	3	3	4	2	1	1	1	4	3	3	2
20/2	4	2	3	3	4	2	1	1	1	4	3	3	2
20/3	4	2	3	3	4	2	1	1	1	1	2	3	2
20/6	4	2	3	3	2	2	1	1	1	4	2	4	2
20/7	4	2	3	3	2	2	1	1	1	4	2	4	2
20/8	4	2	3	3	1	2	1	1	1	1	2	4	1
20/9	4	2	3	3	1	3	1	1	1	1	2	4	1
Key	1 = Very High				2 = High			3 = Moderate			4 = Low		

4.0 SOCIO-ECONOMIC DESCRIPTION

The need for a socio-economic assessment comes directly from the decommissioning obligations under the Petroleum Act (1998) which require that as part of the EIA the potential impact of decommissioning activities on mariculture and other sea users is assessed in addition to the environmental impacts.

This section describes the baseline socio-economic environment at the development in order to allow the assessment of any potential societal impacts of the decommissioning programme.

4.1.1 Shipping

The North Sea contains some of the busiest shipping routes in the world, with significant traffic generated by vessels trading between ports at either side of the North Sea and the Baltic. Whilst the busiest shipping lanes in the North Sea are located in the SNS, the CNS has relatively moderate traffic with an average of 1 to 10 vessels passing through each route per day (DTI, 2001).

Shipping activities in the North Sea are categorised by OGA (2016) to have either: very low; low; moderate; high; or very high shipping density. Figure 4-1 provides an assessment of the level of shipping activity within the area of the E&B fields which is considered moderate.

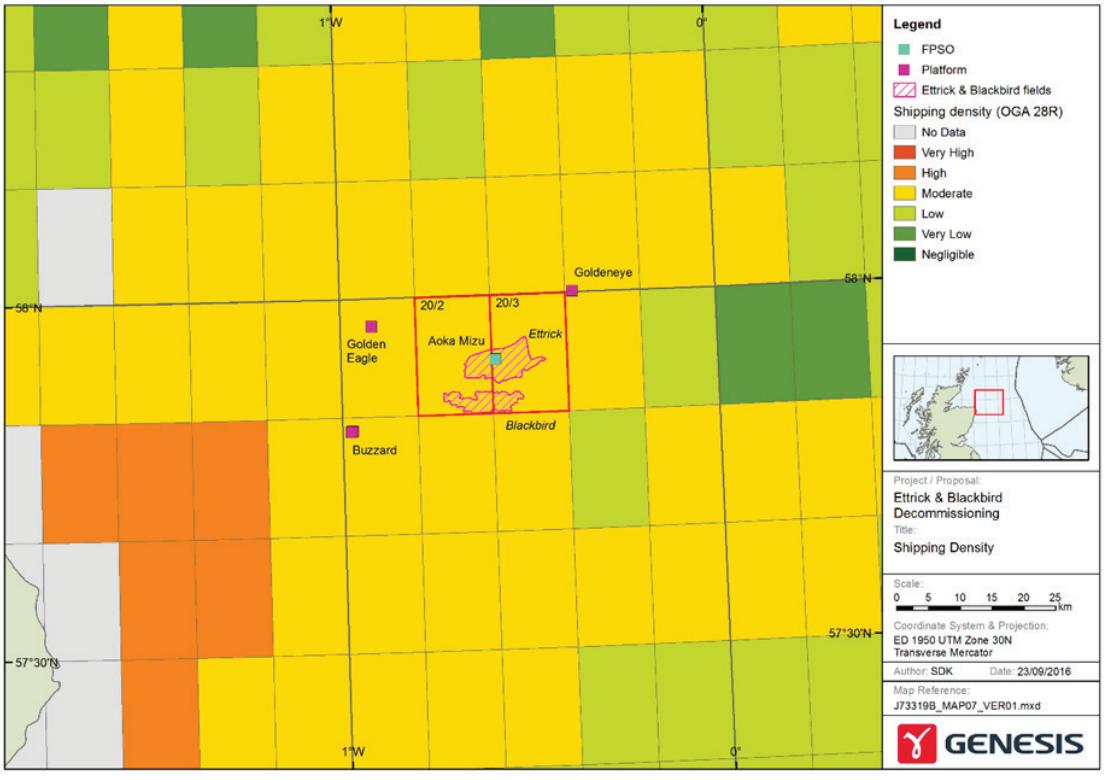

Figure 4-1: Shipping density in the vicinity of the Ettrick and Blackbird fields (DECC, 2014b).

4.1.2 Commercial Fishing

The North Sea supports diverse commercial fisheries. In terms of marine ecosystems, International Council for the Exploration of the Sea (ICES) is the primary source of scientific advice to governments and international regulatory bodies that manage the North Atlantic Ocean and adjacent seas. For management purposes ICES collates fisheries information for area units termed ICES rectangles measuring 30 nm by 30 nm. Each ICES rectangle covers approximately one half of one quadrant i.e. 15 licence blocks. The importance of an area to the fishing industry is assessed by measuring the fishing effort which may be defined as the number of days (time) x fleet capacity (tonnage and engine power). Due to the requirement by UK fishermen to report catch information such as total landings (includes species type and tonnage of each), and location of hauls and catch method (type of gear/duration of fishing), it is possible to get an indication of the value of an area (ICES rectangle) to the UK fishing industry. It should be noted however, that fishing activity may not be uniformly distributed over the whole area of the ICES rectangles. Additionally, the ICES data used is based on values reported for ICES rectangles in which more than five UK vessels (measuring over 10 m) were active. In those ICES rectangles where less than five vessels were active the information is considered to be disclosive and is therefore not available.

The E&B fields lie within ICES rectangle 44E9. Fishing effort by UK vessels (number of vessel days) within the area is considered to be relatively low as indicated by the reported landings data provided in Table 4-1 (Scottish Government, 2016) and illustrated in Figure 4-2.

Table 4-1: Fishing effort (days by UK fishing fleet in ICES rectangles 44E9 and 45E9) (Scottish Government, 2016a).

Effort (days) and the corresponding percentage of UK total reported catch (%)		
Year	**UK total**	**44E9**
2011	188,389	1,198 days
		0.64 %
2012	185,182	570 days
		0.31 %
2013	183,413	115 days
		0.06 %
2014	129,850	1,227 days
		0.94 %
2015*	124,842	1,107 days
		0.89 %
Average 2011 - 2015	162,335	1,045 days
		0.64 %
* Provisional data. Scottish Government, 2016.		

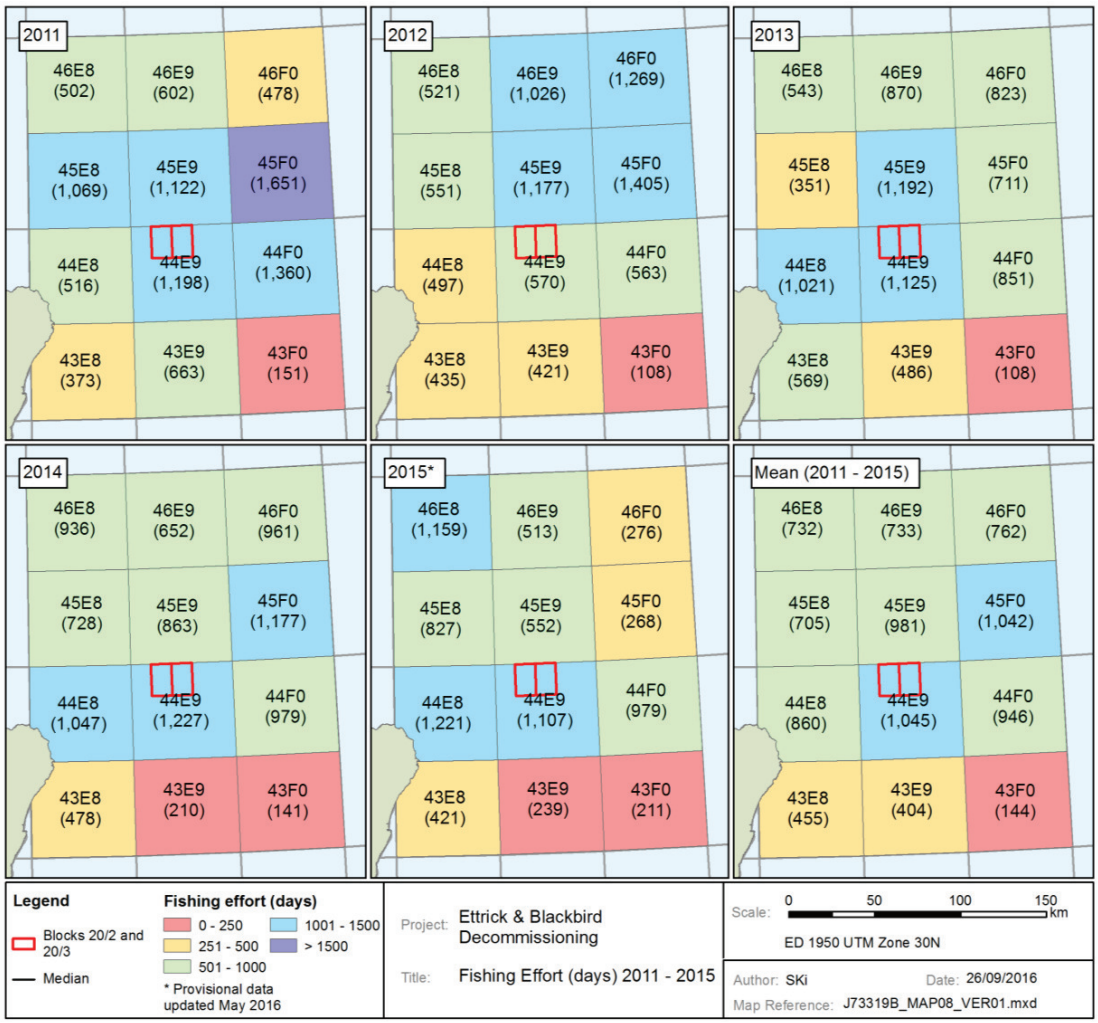

Figure 4-2: Fishing effort (days) in the Ettrick & Blackbird area (Scottish Government, 2016).

Figure 4-3 and Table 4-2 show the value of landings of different fish types (demersal, pelagic or shellfish) from ICES rectangle 44E9. Landings data from between 2011 to 2015 indicate that it is demersal species that are primarily targeted with a total value of £2,658,460 landed from rectangle 44E9 in 2015 (Scottish Government, 2016). These landings equate to approximately 1.3% of the total reported landings of demersal species types at UK ports in 2015, suggesting the area is of relatively low importance to the UK demersal fishing industry. Of the £2,658,460 of demersal fish caught in 2015 (within 44E9), £1,377,416 was haddock, £473,319 monkfish, £273,569 whiting and £139,191 cod.

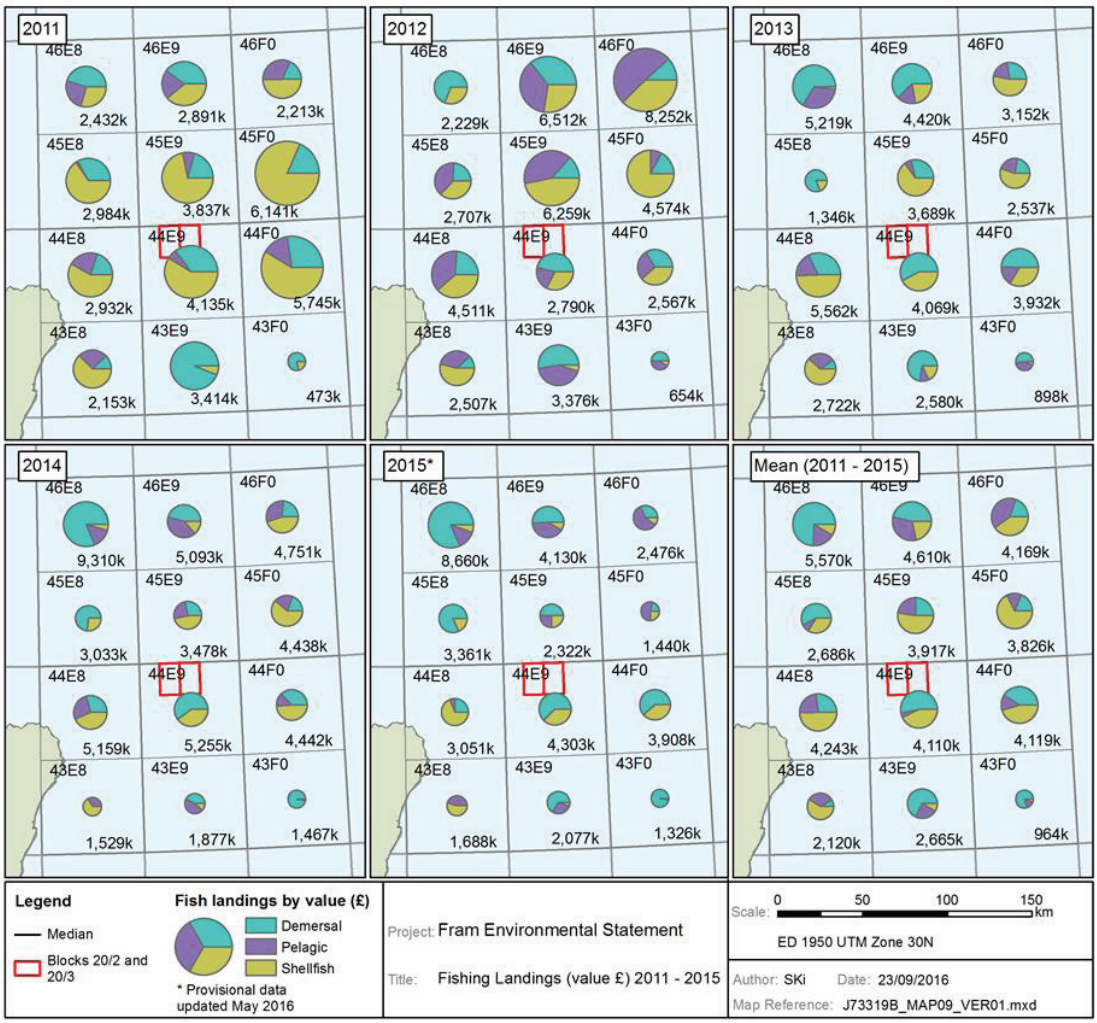

Figure 4-3: Value of fish landings (£) by species type (Scottish Government, 2016).

Table 4-2: Relative value of landings from ICES rectangle 44E9 to total UK catches in 2015*

Year	Values of fisheries landings as a % of UK total landings			
	Demersal	Pelagic	Shellfish	Total
2011	£2,658,460	£19,630	£1,624,654	£ 4,302,744
UK annual total	£205,126,339	£173,299,527	£195,493,099	£ 573,918,965
44E9 landings as a % of UK total	1.3	0.11	0.83	0.75
Source: *Provisional data. Scottish Government, 2016.				

The data presented above corresponds with that reported from the Vessel Monitoring Systems (VMSs) on board the larger UK vessels. UK vessels ≥15 m in length have VMS on board that allow environmental and fisheries regulatory organisations to monitor the position, time at a position, course and speed of fishing vessels. VMS data for all UK registered commercial fishing vessels ≥15 m length for the period 2007-2013 have been combined with landings information to develop GIS layers describing the spatial patterns

of landings of the Scottish offshore fleet from within the Scottish zone of the UK Fishing limits (200 nm) (Kafas *et al*., 2012).

Figure 4-4 shows the fishing intensity by the monitored fishing vessels. The data shows that fishing intensity within the Ettrick and Blackbird area is highest for demersal (mobile) gear. *Nephrops* fishing is most intense to the north west of Ettrick on the Fladen Grounds while herring fishing with pelagic gear is of lower intensity across the fields.

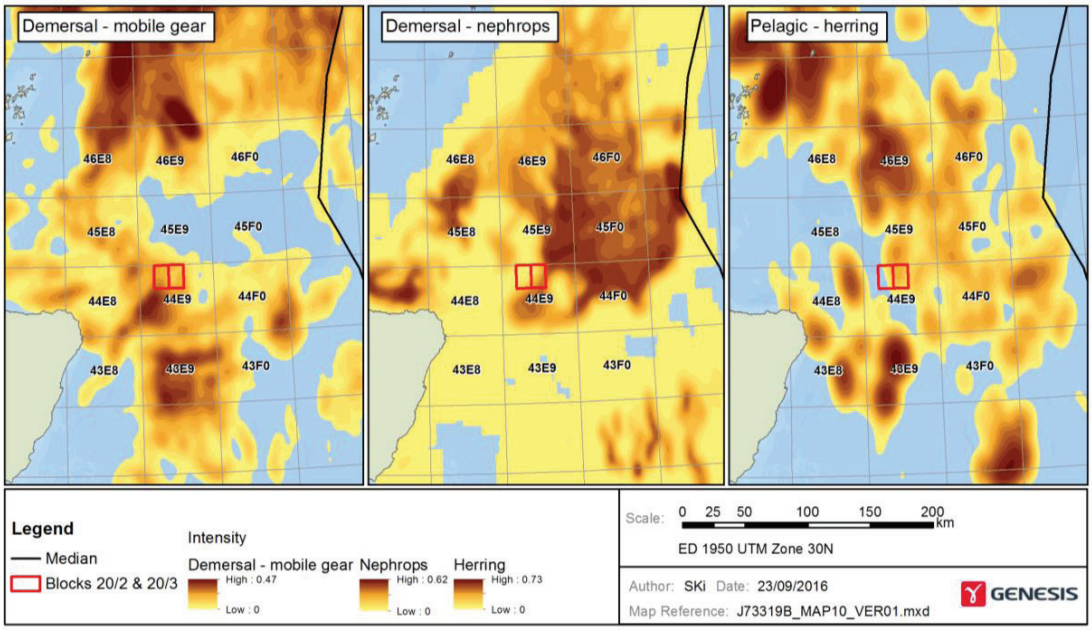

Figure 4-4: VMS data combined from 2009 - 2013 showing the fishing intensity by fishing vessels >15 m in length in the North Sea using demersal mobile gears, Nephrops mobile gears and pelagic herring gears (Kafas et al, 2012).

4.1.3 Other Oil & Gas Developments

Blocks 20/2 and 20/3 are located within a well-developed oil and gas region.

The nearest surface installations are the Goldeneye, the Golden Eagle and the Buzzard Platforms located *c.*15 km, 16 km and 25 km respectively from Ettrick.

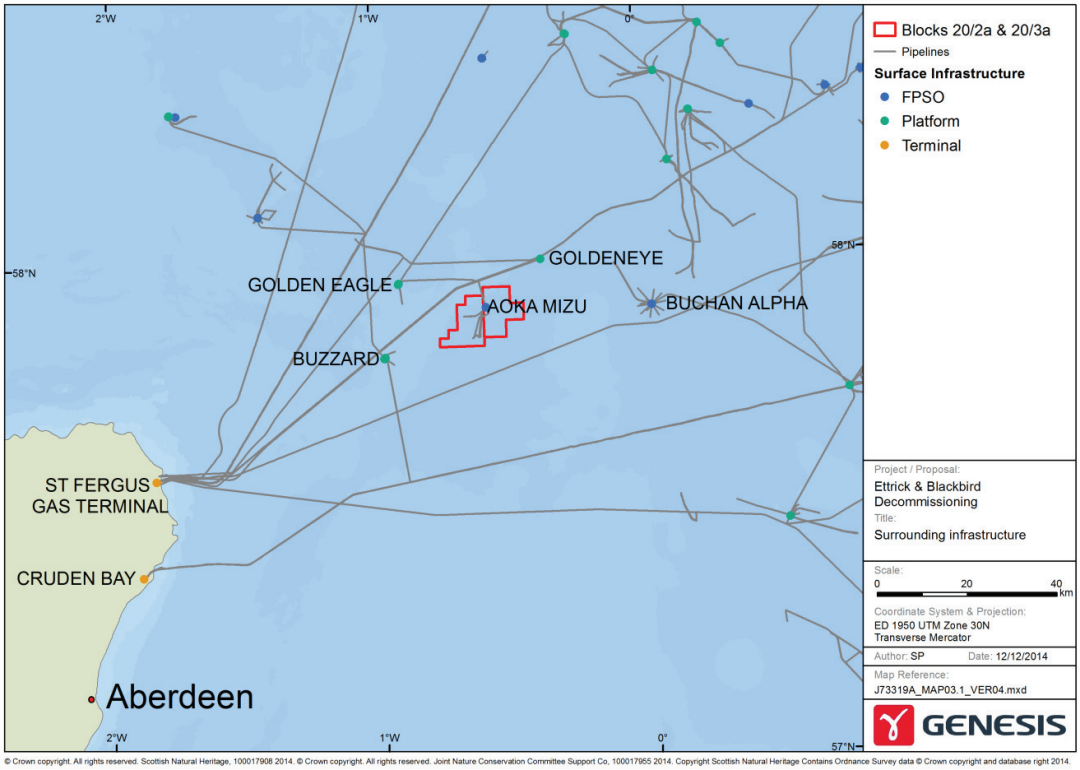

Figure 4-5: Location of oil and gas infrastructure in the vicinity of the Ettrick and Blackbird fields.

4.1.4 Military Exercise Areas

No military activities are known to be undertaken within Blocks 20/2 and 20/3 (DECC, 2014a).

4.1.5 Other Potential Users

There is no tourism, renewable energy or aggregate industries associated with the area.

The closest windfarm development to the E&B developments is the Moray Firth Windfarm which is located *c.*105 km northwest of the blocks.

5.0 THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

This chapter describes the EIA process applied to each of the field Decommissioning Project activities in order to determine their significance.

5.1 Overview

The EIA process identifies the potential environmental effects of a proposed development and aims to prevent, reduce and offset any adverse impacts identified. The requirements for an EIA are defined by the Council Directive 85/337/EEC as amended by Directives 97/11/EC and 2003/35/EC.

For the EIA process, activities likely to have an impact on the environment and potential cumulative and transboundary impacts are first identified. Once identified, these activities are assessed to define the level of potential risk they present to the environment so that, where necessary, such risks can be removed or reduced through design or the adoption of operational measures (mitigation).

5.2 The EIA Methodology

Central to the EIA process is the requirement to identify activities that could cause harm to the environment or other users of that environment. Once identified, these activities are assessed to define their level, i.e. the significance of potential impact that they present, so that measures can be taken to remove or reduce negative impacts through design or operational measures (mitigation).

This EIA is based on the outcomes of an ENVID workshop undertaken on Tuesday 10th June, 2014. The ENVID is a high level tool used to facilitate identification of the environmental and social impacts associated with the project. The ENVID is an appropriate basis for an EIA at this stage as it takes a high-level approach, particularly where specific details of operations are not yet known. Full details of the ENVID, including results can be found in the ENVID report (Nexen, 2014a).

The significance of any potential impact is determined through the use of a risk assessment approach which employs the standard risk assessment philosophy of:

Likelihood of occurrence (frequency/probability) x magnitude of impact (consequence) = Risk

The significance of potential risk is assessed against four drivers:

i. Harm to People
ii. Environment Effects
iii. Financial Impact
iv. Impact on Reputation

For every issue or aspect identified for the project, the potential risk was evaluated by combining the likelihood of occurrence (frequency / probability) (rated A to E as defined in Table 5-1), with the magnitude of the consequences for each of the four drivers indicated above. The highest consequence rating score in any of the driver categories was used (rated minor to catastrophic as defined in Table 5-1). Both components are, at best, semi-quantitative and represent best judgement on the basis of available knowledge and experience, but provide a consistent and documented approach across the whole project.

The overall significance of any potential risk was then determined from the risk matrix (Table 5-1). Definitions of overall significance are provided in Table 5-2.

Once overall impact significance has been assessed, appropriate mitigation measures should be applied to each area of impact with the aim of reducing the level of significance. Once mitigation measures have been applied, issues are reassessed to see if overall impact significance has been reduced.

The outcomes for each of the potential issues identified are presented in the EIA matrix (Section 5.3).

Table 5-1 Nexen's Corporate Assessment Matrix.

Risk = Consequences x Likelihood									
Consequence Describe what is the most likely worst possible undesired consequence under each category (i.e. people, environment, financial and reputation) that might have occurred under slightly different circumstances? For example, a 10 kg dropped object that narrowly missed a worker on the drill floor, could have resulted in a fatality and should be rated as 'Critical (4)' consequence under harm to people.					**Likelihood** How often would it be expected to have similar causes or circumstances aligned for the event with the defined consequences to reoccur? Please make reference to site, company and industry historical data to help predict the reoccurrence frequency of such an event.				
Harm to People Yes / No	**Environment Effects** Yes / No	**Financial Impact** Yes / No	**Impact on Reputation** Yes / No	**Severity**	**A** **Remote:** Few if any events in industry	**B** **Unlikely:** Has occurred several times in industry	**C** **Possible:** Has occurred in company or might occur in life of site	**D** **Probable:** Might occur several times in life of site	**E** **Frequent:** Might happen once a year on site
Multiple worker fatalities or 1 or more public fatalities	Outside spill response assistance required (beyond local co-op). Long term impact and clean up required (> 5 years).	More than $100 million	National or International media attention. Regulators shut down operations.	**5** **Catastrophic**	M	M	H	H	H
Single worker fatality or permanent disability injury/illness	Outside spill response assistance required (local co-op). Long term impact and clean up required (2 to 5 years)	$10 million - $100 million	Regional media attention. Regulatory or legal action taken	**4** **Critical**	L	M	M	H	H
Lost time injury/illness	Company spill response required. Localized, short term impact and clean up required (< 2 years)	$1 million - $10 million	Local media attention. Regulatory or legal action likely	**3** **Major**	L	L	M	M	H
Modified work or medical treatment injury/illness	Reportable event	$100 k - $1 million	Public awareness may exist, but there is no public concern	**2** **Serious**	L	L	L	M	M
First aid injury/illness	Non- reportable event	Less than $100 k	On-site communications	**1** **Minor**	L	L	L	L	M

Table 5-2 Acceptance criterion

Risk	Acceptance Criterion
HIGH	*The risk is unacceptable*. A High HSE Risk activity cannot go ahead; further controls must be put in place to reduce the risk to Medium or lower. Non-HSE High Risk activities require the appropriate stakeholders to review and agree to accept the residual risk level. This must be approved by the appropriate level of management (e.g. VP Operations).
MEDIUM	*The risk is tolerable if it has been reduced to ALARP (As Low As Reasonably Practicable):* A Medium Risk activity may go ahead provided that all reasonably practicable controls have been identified and put in place.
LOW	*The risk is broadly acceptable if it is managed*, which means that a Low Risk activity may go ahead, but consideration should be given to means for further reducing the risk.

5.3 Assessment of Potential Impacts and Control Measures

Using the information provided in Sections 2, 3 and 4 and the criteria set out in Section 5, an ENVID Workshop was held to identify the environmental aspects and assess their potential environmental impact and risk. The results of the ENVID are presented in Appendix A.

The environmental aspects which were either: subject to regulatory control; or were found to pose a moderate or high risk to the environment; or were recognised during the consultation phase as areas of public concern, were further assessed and are described in Section 6.

6.0 FURTHER ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

From the ENVID (see Appendix A) it was found that none of the planned activities associated with the decommissioning, P&A and subsequent environmental surveys are likely to have a significant environmental impact. However, due to some aspects being under regulatory control and/or of public interest, this section further describes the impacts. The aspects considered include:

- Energy use and emissions to air;
- Discharges to sea;
- Solid deposits on the seabed and disturbance to seabed
- Underwater noise;
- Waste Management and Resource Use: and
- Accidental Events.

6.1 Energy Use and Atmospheric Emissions

This section provides an assessment of the estimated energy use and atmospheric emissions produced as a result of the proposed decommissioning activities. Control and mitigation measures intended to achieve optimum energy efficiency and reduce emissions are also considered.

The Energy Institute (formerly the Institute of Petroleum) produced Guidelines for the Calculation of Estimates of Energy Use and Gaseous Emissions in the Decommissioning of Offshore Structures (IoP, 2000). The approach set out has been used as the basis for the energy balance assessment carried out here. The main steps of the assessment included:

- Establishment of a materials inventory for each structure to be decommissioned;
- Identification of all operations associated with decommissioning;
- Identification of all end points associated with decommissioning each structure, where end points are defined as the final states of the materials at the cessation of the decommissioning operations, including the presence of material in landfill sites or on the seabed.
- For each operation and end point, identification of the associated activities that will be a source of energy use and atmospheric emissions; and
- Selection of conversion factors and calculation of energy use and atmospheric emissions.

6.1.1 Activities (Cause of Impact)

Activities considered likely to consume energy and lead to emissions to atmosphere include:

- Offshore operations;
- Recycling and recovery of materials; and
- Manufacture of materials to replace those decommissioned in-situ.

It should be noted that onshore transportation of recovered materials is not expected to be carried out at a scale that would lead to significant additional emissions when considered in the wider context of general onshore transportation activities. They are therefore not considered further here.

The principal emissions local to the E&B developments will be the releases of combustion gases from the drilling rig and vessel and engines. The drilling rig and vessel requirements and anticipated fuel use for the proposed activities are presented in Table 2-5 whilst Table 6-1 presents the anticipated emissions associated with this total fuel use.

Table 6-1: Energy use and emissions associated with vessels (including the drilling rig)

Source	Fuel Use (te)	Energy Use (GJ)	Emissions from fuel use (te)						
			CO_2	NO_x	N_2O	SO_2	CO	CH_4	VOC
Total vessels (including drilling rig)	16,493	710,827	52,776	980	4	33	259	3	33
UK Shipping emissions 2014 (CCC, 2016)			9,900,000						
Total vessel emissions as a % of 2014 UK shipping emissions			0.53						

The total anticipated annual CO_2 emissions associated with the vessels comprise around 0.53 % of total emissions from shipping the UKCS in 2014 (CCC, 2016), however as the decommissioning and P&A activities will be spread over a number of years the annual contribution in any one year will be significantly less.

6.1.1.1 Recycling, Recover and Manufacture of Materials

Recycling and recovery of materials from the structures to be recovered to shore will have an energy demand and associated emissions. These will primarily be associated with the recovery of the steel. Whilst leaving materials *in situ* has no energy use or associated emissions to atmosphere, the energy use and emissions used to replace those “lost” materials can be calculated using the Institute of Petroleum (IoP) guidelines. The consideration of these allows the energy use and emissions from the other activities to be put into context.

The estimated emissions associated with the recycling of the E&B infrastructure to be recovered, as well as those associated with producing equivalent volumes of steel that will be decommissioned in situ have been calculated using the IoP Guidelines (IoP, 2000) (Table 6-2). It is anticipated that recycling of recovered metals other than steel will not be undertaken on a scale that will lead to significant additional emissions, so they are not considered further. Recovered concrete (e.g. from mattresses) may be crushed for reuse, an activity considered to have a relatively low energy demand and therefore are also not considered further.

Table 6-2: Energy use and emissions from recycling and replacement of steel

Infrastructure	Steel (te)	CO_2 (te)	Energy Use (GJ)
Emissions associated with recycling of recovered steel			
Ettrick installations	4,019	3,945	36,981
Ettrick pipelines	1,345	1,291	12,105
Blackbird installations	306	294	2,754
Blackbird pipelines	1,030	989	9,270
Steel recycling total	**6,790**	**6,518**	**61,110**
Emissions associated with replacement of steel left *in situ*			
Ettrick installations	949	1,793	23,725
Ettrick pipelines	1,629	3,077	40,725
Blackbird installations	44	83	1,100
Blackbird pipelines	2,126	4,016	53,150
Steel replacement total	**4,748**	**8,969**	**118,700**
Overall steel total	**11,538**	**15,487**	**179,810**

6.1.2 Impact on Receptors

Approximately 43 % of the total CO_2 emissions for the proposed E&A decommissioning activities is related to the onshore recycling of materials from the seabed and the manufacture of materials to replace those decommissioned in situ. When compared against the 13 million tonnes of carbon dioxide equivalent (CO_2e) emitted from industry across the UK (Scotland, England, Wales and Northern Ireland) in 2014 (DECC, 2016) the anticipated CO_2 emissions captured in Table 6-2 represent c. 0.1 % of total CO_2e industry emissions.

The energy consumption associated with the decommissioning activities for E&B fields is expected to lead to the emission of combustion gases including CO_2, methane (CH_4), nitrogen oxides (NO_x), sulphur dioxide (SO_2) and Volatile Organic Compounds (VOCs).

The direct impact of NO_x, SO_2 and VOC in the atmosphere is the formation of photochemical pollution in the presence of sunlight, comprising mainly low level ozone, but by-products may include nitric acid, sulphuric acid and nitrate-based particulate. The formation of acid and particulates may lead to a contribution to acid rainfall and the dry deposition of particulates. If such deposition occurs at sea, it is possible that the substances will dissolve in sea water but the level of deposition is unlikely to lead to any significant impacts on local sea water composition due to the relatively small amount when compared to emissions from other vessels. In addition, the ultimate fate of atmospheric emissions can often be difficult to predict owing to the dependence on variable weather (especially wind), over quite short timescales.

CO_2 emissions contribute to greenhouse gas emissions and global warming impacts. The total estimated vessel CO_2 emissions produced as part of the decommissioning operations in relation to the total CO_2 produced from UK domestic shipping (CCC, 2016) is c. 0.2 %. In addition, there will be a contribution to global warming from other gaseous emissions, the overall global warming potential (GWP - a relative measure of how much heat a greenhouse

gas traps in the atmosphere). The contribution will be proportional to the volume of emissions, as for CO_2. Therefore the overall GWP will also constitute a relatively small increase to existing emissions. The significance of the impact of CO_2 emissions from the E&B decommissioning activities has been assessed as low.

In general, environmental conditions offshore will lead to rapid dispersion and dilution of any emissions to atmosphere. The E&B facilities are located c.70 km from the nearest UK coastline. Offshore weather conditions will mean that impacts will be localised and short term. It is considered that the emissions to atmosphere from the E&B decommissioning activities are unlikely to lead to any significant impacts on either sea water quality or air quality and not have a significant contribution to global warming. The significance of impacts on either seawater quality or air quality has been assessed as low.

Section 3 describes the biological environment and the receptors which could be impacted by atmospheric emissions. Within the vicinity of E&B there are receptors present throughout the year including fish spawning and nursery grounds, marine mammals (with the highest sensitivity during the summer months) and seabirds (with the highest sensitivity during the summer months). Although there are receptors present throughout the year, given the relatively short duration of the activities and the rapid dispersion in the area, the significance of the impact on the receptors is assessed as low.

6.1.3 Transboundary and Cumulative Impacts

The E&B facilities are located *c.*142 km west of the UK/Norwegian median line. The transboundary impact of atmospheric emissions arising from the decommissioning activities at E&B are expected to be of low significance owing to the rapid dispersion and dilution of emissions which will occur in offshore weather conditions and over distance.

In relation to the current levels of shipping traffic which already pass E&B, the expected emissions from the decommissioning activities will represent a small incremental addition to emissions of combustion gases which already occur over a relatively short time period. Therefore, although the emissions to air will contribute to global warming, the cumulative impact on receptors from the atmospheric emissions generated by the decommissioning activities for E&B have been assessed as of low significance.

6.1.4 Control and Mitigation Measures

In line with the Nexen's routine environmental management of vessels, the following control and mitigation measures have been identified to optimise energy consumption and reduce the significance of the impacts from atmospheric emissions:

- Prior to the mobilisation, vessels will be selected and assessed to ensure maintenance of generators and engines which leads to better efficiency in line with manufacturer's specifications; and
- Decommissioning vessel schedules will be planned to optimise (minimise) vessel use.

6.1.5 Conclusion

The principal energy use and generation of emissions to air local to the E&B developments will arise from fuel combustion for propulsion and power generation by the vessels required for the activities. These emissions will include components which have the potential to contribute to global warming, acid rainfall, dry deposition of particulates and photochemical

pollution or cause impacts on local air quality. It is expected that impacts will be low significance as they will be short term.

The energy usage from the decommissioning of the E&B infrastructure is estimated to be 710,827 GJ direct (vessel use and drilling rig) and 179,810 GJ indirect requirements (manufacture of new materials to replace those decommissioned in situ and those recovered should none of them be reused).

Total direct CO_2 emissions generated by the proposed decommissioning activities comprise emissions from vessels and drilling rig estimated to equate to 0.53 % of total emissions from shipping the UKCS in 2014 (CCC, 2016). However as discussed the decommissioning and P&A activities will be spread over a number of years such that the annual contribution in any one year will be significantly less. Emissions to atmosphere from the decommissioning activities are unlikely to significantly contribute to greenhouse gas emissions or global warming impacts.

Standard mitigation measures to optimise energy usage by vessels will include operational practices and power management systems for engines, generators and any other combustion plant and planned preventative maintenance systems for all equipment for peak operational efficiency.

6.2 Discharges to Sea

The decommissioning operations have the potential to lead to the discharge of liquids into the sea. Whether these discharges actually occur is influenced by the following factors:

- The effectiveness of the preparation and pre-decommissioning activities;
- Operational practices and procedures adopted by vessels (both at the surface and subsea), including accident prevention measures; and,
- Maintenance practices and procedures of the vessels intended to secure the containment integrity of all equipment (e.g. pipework).

This section discusses the potential for planned discharges to sea which may arise as a consequence of the E&B decommissioning operations. Unplanned/accidental releases are discussed separately (Section 6.6).

6.2.1 Activities (Cause of Impact)

Discharges of inhibited seawater with possible residual hydrocarbons will take place when the pipeline ends and spool pieces are lifted through the water column. Detailed discharge information will be captured in the relevant chemical permit applications.

During wellhead severance and other cutting activities small quantities of inert abrasive cutter may be discharged into the sea.

Discharges to sea from vessels (including the drilling rig) in the field are characterised as normal operational discharges and are subject to on-board control measures designed to secure compliance with the requirements of MARPOL 73/78. These discharges include:

- Ballast water;
- Bilge water;
- General shipboard drainage;
- Treated sewage and grey water from accommodation and amenities; and
- Unplanned releases of diesel, hydraulic fluid or other hydrocarbons (see Section 7.6).

Equipment may be contaminated with NORM. NORM contaminated items will be contained, tagged and shipped to shore for treatment and disposal at a licensed processing facility. Limited discharge of NORM to sea in line with the Certificate of Authorisation will take place during Vessel Deck cleaning. There will be no planned discharge as all contaminated equipment will contained in the removed, bagged and tagged infrastructure.

6.2.2 Impacts on Receptors

All of these aspects primarily impact the seabed and the water column with benthos and plankton being the main receptors.

The likelihood of detectable impacts on the surrounding waters from discharges of small quantities of residual hydrocarbon is considered to be negligible as hydrodynamic conditions at the seabed are likely to be such that rapid dispersion and dilution will occur. Any impacts will be localised and short term.

Any hydrocarbon discharges will be permitted under the Offshore Petroleum Activities (Oil Prevention and Control) Regulations 2005 (as amended) (OPPC) prior to undertaking the activities. Proposed chemical discharges will be subject to a chemical risk assessment and permitted under the Offshore Chemicals Notification Scheme (OCNS) (Offshore Chemicals Regulations (OCR) in the UK and Environmental Permit in the Netherlands).

Any discharges from vessels in the field will impact water quality immediately around the site at the time of discharge, but impacts will be minimal due to the rapid dilution and dispersal of any pollutants. Impacts are therefore anticipated to be short term and localised.

6.2.3 Transboundary and Cumulative Impacts

Discharges to the marine environment may lead to short-term, localised impacts on marine organisms which are relatively close to the discharge point such that impacts on Norwegian waters, *c.* 142 km away from the E&B fields are anticipated to be negligible.

Cumulative impacts are considered to be highly unlikely since the impacts arising from discharges are expected to be short term with rapid dispersion.

6.2.4 Control and Mitigation Measures

The released chemicals will be permitted under the UK OCR. Once final chemical requirements are known, and prior to commencement of these activities, Nexen will submit the relevant chemical permit applications supported by appropriate detailed chemical risk assessments to BEIS in order to obtain approval prior to chemical discharge. Chemicals will be selected both on their technical specifications and their environmental performance.

Any discharges of NORM to sea will be minimised and will be within currently authorised levels.

Discharges from vessels will be controlled and minimised through the use of operating procedures and systems for optimum performance, including planned preventative maintenance systems for peak operating efficiency of on-board systems for the management of effluent, ballast water and bilge water. All vessels and the drilling rig contractors will be assessed prior to final selection to ensure the necessary controls are in place.

Suitable technology for cutting the well heads will be selected to ensure the effectiveness and minimise the duration of the cutting operations.

6.2.5 Conclusions

There is the potential for small quantities of residual chemicals and hydrocarbons to be released into the water column from lifting of subsea infrastructure and from vessels used for decommissioning. The seabed and the water column are the primary receptors. Mitigation includes a successful post-COP deoiling programme, chemical selection processes, permitting of hydrocarbon and chemical discharges and strict vessel operating procedures. All of these impacts will be localised and short term given the highly dynamic environment around E&B

6.3 Solid Deposits on the Seabed and Disturbance to the Seabed

This section provides an assessment of the impact on the seabed as a result of the decommissioning workscope. The impacts is assessed by determining the area of seabed disturbance as a result of recovery of subsea infrastructure, placement of rock and dredging. Control and mitigation measures intended to minimise the impact are also considered.

6.3.1 Activities (Cause of Impact)

Disturbance to the seabed will occur as a result of:

- Removal of the Aoka Mizu's anchor system;
- Positioning and anchoring of the semi-submersible drilling rig at the E&B fields. It is anticipated the rig will be require to be positioned on four different locations to complete the P&A activities;
- Cutting of piles and wellhead structures;
- Jetting to clear sediment away from pipelines;
- Disturbance of sediment in the area of the recovered spools and end sections of the pipelines and subsea infrastructure;
- Placing of the DTB, risers and dynamical umbilicals and midwater arches on the seabed as temporary wet storage prior to removal;
- Recovery of mattresses and grout bags;
- Additional rock cover at locations identified in Section 2.6.3; and
- Accidental disturbance to the seabed could result from dropped objects; for example, when recovering the infrastructure.

6.3.2 Impact on Receptors

An estimate of seabed disturbance associated with the proposed decommissioning activities is given in Table 6-3. From the table it can be seen that the disturbance associated with the majority of the proposed activities is considered temporary such that infrastructure is being recovered and the seabed can begin to recover once the activities have been completed. Only the addition of rock cover on those sections of pipeline where DoC or DoL is of concern will cause a permanent impact.

Table 6-3: Anticipated area of seabed disturbance.

Infrastructure	Assumptions made	Area impacted (km^2)
9 mooring anchors	Assumes the area of disturbance when jetting and severing the top 3 m of each anchor is 10 m x 10 m.	0.0009 (temporary)
9 anchor lines	Assumes a maximum length of 1,460 m of each line impacts on the seabed across a corridor width of 10 m.	0.1314 (temporary)
Recovery of surface laid sections of trenched and buried pipelines and umbilicals	Total length of risers and dynamic umbilicals to be recovered is 2,090 m. The area of seabed disturbance is assumed to be a corridor width of 10 m, allowing for sediment to be moved from current location over the partially buried pipeline to either side where applicable	0.0209 (temporary)
Recovery of spools and umbilical jumpers	Total length of spools and umbilical jumpers to be recovered is 2,145 m. The area of seabed disturbance is assumed to be a corridor width of 10 m, allowing for sediment to be moved from current location over the partially buried pipeline to either side where applicable.	0.02145 (temporary)
Dredging of transition ends	As a worst case it is assumed that 30 m will be dredged at each end of each of the trenched and buried flowlines and umbilicals (total of 840 m disturbed). Assuming jetting is required a corridor of disturbance of 10 m is assumed.	0.0084 (temporary)
Recovery of mattresses	To calculate the area of disturbance associated with the removal of the 401 mattresses measuring 6 m x 3 m an additional impacted area of 2 m was assumed on each side (i.e. total area impacted by 1 mattress is 10 m x 7 m).	0.028 (temporary)
Recovery of grout bags	Recovery of 5,000 x 25 kg grout bags. These grout bags are a mixture of individual laid 25 kg grout bags measuring 0.5 m x 0.55 m and 1 Te grout gabions containing 40 x 25 kg grout bags. As a worst case the assessment assumes all grout bags are laid individually. The area of impact of a single grout bag (25 kg) is assumed to be 0.5m x 0.5m.	0.0084 (temporary)
Recovery of subsea structures	13 wellheads, 12 Xmas trees and associated control modules, two manifolds, one SSIV, four SDU, two valve skids, one pigging skid, riser base and hold back piles, DTB, Mid water arch and base, two clump weights (see Table 2-1 for dimensions). Area of disturbance assumes disturbance up to 2 m at each side of each structure. All of these structures will be completely removed from the seabed by lifting onto vessel. Any driven piles will be cut below the seabed level whilst Nexen will endeavour to remove any suction can piles. Mechanical cutting tools are most likely to be used to sever the driven pile.	0.0045 (temporary)
Drilling rig anchors and mooring lines	Assumes a worst case of a semi-submersible requiring 12 anchors. Anticipated the rig will be positioned up to 4 times. Therefore 48 placements of drill rig anchors. Assumes area of impact by each anchor positioning is $4m^2$. Assumes up to 200 m of each anchor line impacts on the seabed across a corridor width of 10 m	0.0962 (temporary)
Rock cover	Estimated that a length of 1,795 m of pipeline will require rock cover where there are concerns regarding DoL and	0.013 (permanent)

	DoC. This rock will impact on a corridor width of 7 m (see Section 2.6.3). Possible requirement for rock cover at transition ends. Assumes a worst case of 5 m of rock cover impacting on a corridor width of 7 m required at both ends of the 14 trenched flowlines/umbilicals. Nexen will endeavour to minimise the placement of any additional rock in the fields.	
Total estimate of temporary disturbance		0.312 km^2
Total estimate of permanent disturbance		0.013 km^2

It should be noted that the estimates of seabed disturbance associated with the proposed E&B decommissioning activities do not include disturbance caused by the potential use of baskets to retrieve spools and pipeline ends, etc. At the time of writing it was not yet known how many baskets would be required. The seabed disturbance caused by the use of baskets, transponders etc. will be assessed in an environmental permit application closer to the time of activity. It is unlikely that activities associated with the decommissioning activities will impact on an area greater than 0.4 km^2 after the disturbance caused by recovery baskets is accounted for. Table 6-3 also does not account for the debris surveys and overtrawl trials which will be undertaken on the completion of decommissioning activities. Seabed disturbance from debris surveys would occur at the two fields and would be temporary in nature.

Impacts from recovery activities may result in the direct physical injury of benthic species and the re-suspension of seabed sediments which can impact on habitats/species outwith the immediate area of activity as disturbed sediment particles may be transported via tidal currents. Jetting is used to clear sediments away from pipelines and results in liquefaction and coarse sediment deposition. The width of the disturbance zone associated with jetting is typically about 5 m but fine-grained silt and clay may disperse further (Carter, 2010). A conservative disturbance zone of 10 m has been allowed for in Table 6-3.

The re-suspension of sediments can result in the smothering of epifaunal benthic species (Gubbay, 2003). Whilst some species may be exposed to settlement of only a small layer of sediments and be unaffected, others may experience thicker smothering or be unable to tolerate any covering at all. Sessile epifaunal species may be particularly affected by increases in suspended sediment concentrations as a result of potential clogging or abrasion of sensitive feeding and respiratory apparatus (Nicholls, 2003). Larger, more mobile animals, such as crabs and fish, are expected to be able to avoid any adverse suspended solid concentrations and areas of deposition. In the case of filter feeders, such as *Arctica islandica,* an increased suspended sediment concentration could impact the ability to feed. Infaunal species that are found within the sediment may be less susceptible to the negative impacts of smothering. Conversely, re-suspension of fine particulate matter may clog the delicate filtering apparatus of suspension feeders, which can result in their removal from silty sediments.

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

The ability for organisms to detect predators may also be reduced as a result of low visibility associated with suspended sediments. In instances of persistent and widespread suspended sediments there is the possibility of reduced feeding success among juvenile fish which may influence survival, year-class strength, recruitment and overall condition (Clarke, 2000).

Rock cover will directly impact a number of sections along the pipelines (Section 2.6.3). The width of impact is taken as 7 m based on the typical rock berm profile. Sediments may be temporarily disturbed over a slightly greater corridor width but any resuspension of sediment would be short term, only occurring during the actual rock placement operations.

Removal of the infrastructure means that the seabed beneath the recovered infrastructure can begin recovery. Site surveys conducted across the project area have not identified any sensitive habitats, sensitive species or habitats/species of particular conservation concern. In addition, the majority of benthic species which were identified in the surveys are widely distributed and it is expected that they will to return to the disturbed area after the work is completed.

Any impacts from the proposed decommissioning activities are expected to be short lived since most of the smaller sedentary species associated with the area (such as polychaete worms) have short lifecycles and recruitment of new individuals from outside the area disturbed will be rapid. Re-colonisation of the impacted areas can take place in a number of ways, including mobile species moving in from the edges of the area (immigration), juvenile recruitment from the plankton and burrowing species digging back to the surface.

Marine growth is entirely organic in origin, therefore any marine growth which falls into the sea is unlikely to lead to any impact other than a short term increase in suspended solids. This is likely to be rapidly dispersed by hydrodynamic conditions. Marine growth will naturally biodegrade within the normal ecosystem cycle and it is highly unlikely that it will lead to detectable impacts therefore the impact is considered to be low.

6.3.3 Transboundary and Cumulative

The E&B fields are located *c.* 142 km from the UK/Norwegian median line. As the impacts from the decommissioning activities will be relatively local and short term, significant transboundary or cumulative impacts are not anticipated.

6.3.4 Control and Mitigation Measures

The following measures will be adopted to ensure that seabed disturbance and its impacts are minimised to ‘as low as reasonably practicable’:

- All activities which may lead to seabed disturbance will be planned, managed and implemented in such a way that disturbance is minimised;
- A seabed survey will be carried out and detailed anchoring plans for the drilling rig will be put in place;
- Rock placement will only be undertaken in limited areas for the pipelines which are remaining in situ, and in line with the options selected at the comparative assessment;
- A fall pipe will be used to direct the rock cover to the correct location;
- Careful planning, selection of equipment, and management and implementation of activities (especially water-jetting);
- All dropped objects will be reported to BEIS via a PON 2 and Nexen will aim to recover all dropped objects; and

- A debris survey will be undertaken at the completion of the decommissioning. Any 'foreign' material, identified as resulting from decommissioning activities will be recovered from the seabed where possible. Those not recovered will be entered into the FishSafe database.

6.3.5 Conclusion

The principal sources of seabed disturbance associated with the E&B decommissioning activities concern the removal of structures, spools, mattresses and grout bags, cutting operations, anchoring of the semi-submersible drilling rig and the placement of additional rock cover on the exposed pipeline ends. These activities will result in the displacement of substrate and the suspension and subsequent settlement of sediment. Standard measures to control disturbance include operational planning and equipment selection.

The species and habitats observed in the vicinity of the E&B fields are relatively widespread throughout the CNS and the area anticipated to be impacted represents a very small percentage of the available habitat. Furthermore, all disturbed sediments are expected to recover rapidly though recruitment from adjacent undisturbed areas.

In summary, due to the localised and relatively short duration of the decommissioning activities, and with the identified control and mitigation measures in place, the overall significance of the impact of seabed disturbance as a result of the decommissioning of E&B fields is considered to be low.

6.4 Underwater Noise

This section considers the impact on marine receptors of underwater noise generated during the proposed E&B decommissioning activities. The impact is assessed by reviewing the type of noise likely to be generated and documented evidence of the effects of such noise on marine receptors, and comparing the expected noise levels with recognised thresholds for impacts.

6.4.1 Activities (Cause of Impact)

Human activities at sea generate underwater sound. The characteristics of the sound produced, in terms of the amplitude, range of frequencies and temporal features, varies with the type of activity and equipment. Sound levels in the marine environment diminish with distance from the source.
The main sources of underwater sound associated with the proposed decommissioning activities at E&B will be:

- Acoustic surveying equipment;
- Vessels of various types, all of which will be using DP;
- Cutting tools and other diver tools;
- Placement of rock cover.

It is not known at this stage whether acoustic surveys would be required as part of the post decommissioning survey and monitoring programme as visual surveys may suffice. However, potential impacts from acoustic surveying has been included as a worst case scenario.

As shown in Table 2-5 a range of specialist and support vessels (DSV, CSV, AHV, rock cover vessel, guard vessels) will be required to undertake the proposed decommissioning

activities. The total number of days during which vessels are anticipated to be present in the E&B fields is 870, with up to 5 vessels being on location at any one time.

Cutting activities will take place at the wells, within the FPSO 500 m zone to cut the mooring lines and risers, the MWA tethers, at the exposed pipeline and umbilical ends and at the various subsea structures (manifolds, SSIV, SDUs etc.).

The manifold and mooring piles will need to be cut.

Rock cover will be required at some of the pipeline ends on those sections of pipeline and umbilicals where DoC and or DoL is of a concern (see Table 2-4). A fall pipe will be used to accurately lay the rock cover at the required locations.

6.4.2 Impacts on Receptors

Harbour porpoise, minke whale, white-beaked dolphin, white-sided dolphin, Risso's dolphin and killer whale have been sighted in the E&B development area (Reid *et al.,* 2003). Sightings mainly occurred in the summer months (see Section 3.3.4.). A range of fish species use the area for nursery and / or spawning ground at different times of the year including haddock, lemon sole, mackerel, sprat and whiting (Coull *et al.*, 1998). Further details are given in Section 4.2.3.

Sound is important for marine mammals for navigation, communication and prey detection (Southall, 2007; Richardson, 1995). Introduction of anthropogenic underwater sound, therefore, has the potential to impact on marine mammals if it interferes with the ability of an animal to use and receive sound (OSPAR, 2009). The impact of sound on an animal depends on many factors including the level and characteristics of the sound, hearing sensitivity of the species and behaviour of the species.

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

6.4.2.1 Acoustic Surveying Equipment

Seabed surveys carried out as part of decommissioning will typically employ acoustic surveying equipment such as side-scan sonar (SSS) and echo sounders to generate images of the seabed. Airguns are not expected to be used.

The impact of acoustic survey equipment sound on marine mammals depends on frequency, pulse characteristics (e.g. duration, repetition rate and intermittency), source and received levels, directivity, beam width and receptor species. A review of the impact of acoustic surveying techniques on marine fauna in the Antarctic concluded that acoustic instruments such as SSS and many echo sounders are of sufficiently low power and high frequency as to pose only a minor risk to the environment. Airguns and low-frequency, high power transducers with a wide beam width are of greater concern (SCAR, 2002). This concurs with a review by Richardson *et al*., (1995), which found most evidence for a behavioural response to sonar operating at frequencies around 3 kHz to 13 kHz and no obvious response to pingers, echo sounders and other pulsed sound at higher frequencies unless the received levels were very high. Behavioural responses included avoidance and changes in swimming behaviour and vocalisation.

For echo sounders operating in shallow water depths such as at the E&B fields, the high-end of frequencies outside the hearing range of marine species are used, which attenuate

rapidly, and the operating power is lower than in deeper water (JNCC, 2010). Under these conditions JNCC considers that injury or disturbance would be unlikely. Similarly, JNCC consider the risk of injury or disturbance from SSS to be negligible because of the high frequencies that are outside the hearing range of marine mammals and attenuate rapidly and the short duration of this type of survey.

Very little information is available on the potential effects of SSS and echo sounders on fish (Popper, 2008 and ICES, 2005). Experiments exposing caged fish of various species to mid-frequency (2.8-3.5 kHz) sonar at a received sound pressure levels (SPL) of 210 dB re 1µPa root-mean-square (rms) found evidence of temporary hearing damage in fish with hearing sensitivity in the frequency range generated by the source but not those with lower frequency hearing. Hearing damage recovered within 24 hours and no evidence of pathology or mortality was found (Halvorsen *et al*., 2012).

Unpublished work by the Norwegian Defence Research Establishment (Jorgensen *et al*., 2005; presented in Kvaldsheim *et al*., 2005) exposed larval and juvenile fish to simulated sonar signals at 1.5 kHz, 4 kHz and 6.5 kHz to investigate potential effects on survival, development and behaviour. The fish species used were herring (*Clupea harengus*), Atlantic cod (*Gadus morhua*), saithe (*Pollachius virens*) and spotted wolfish (*Anarhichas minor*). Received sound levels ranged from 150 to 189 dB re 1 µPa. The only effects on fish behaviour were some startle or panic movements by herring for sounds at 1.5 kHz and there were no long-term effects on behaviour, growth or survival. There was no damage to internal organs and no mortality apart from in two groups of herring (out of over 40 tests) at received sound levels of 189 dB, for which there was a post-exposure mortality of 20 to 30%. Herring can detect higher frequencies than are detected by the other species in the study.

6.4.2.2 Vessels

The primary sources of sound from vessels are propellers, propulsion and other machinery (Ross, 1976 and Wales *et al*., 2002). In general, vessel sound is continuous and results from narrowband tonal sounds at specific frequencies and broadband sounds. Acoustic broadband source levels typically increase with increasing vessel size, with smaller vessels (< 50 m) having a source rms sound pressure level (SPL) of 160-175 dB re 1 µPa at 1 m, medium size vessels (50-100 m) 165-180 dB re 1µPa at 1 m and large vessels (> 100 m) 180-190 dB re 1 µPa at 1 m (Richardson *et al*., 1995). However, sound levels depend on the operating status of the vessel and can vary considerably in time. Acoustic energy is strongest at frequencies below 1 kHz.

Some of the vessels used for the proposed activities will use DP systems to maintain and adjust their position when working. Sound levels can be louder during use of DP, which requires the operation of thrusters to control a ship's location.

Richardson *et al*. (1995) reviewed the effects of vessel noise on marine mammals. They noted that it is not always possible to distinguish between effects due to the sound, sight or even smell of a vessel to an animal but there is evidence that noise from vessels has an impact on marine mammals. Animals have been reported to display a range of reactions from ignoring to avoiding the noise. The latter can lead to temporary displacement from an area.

Vessel noise can mask communication calls between cetaceans, reducing their communication range (Jensen *et al*., 2009). Exposure to low frequency ship noise may be associated with chronic stress in whales. Rolland *et al*., (2012) reported a decrease in baseline levels of stress-related faecal hormones concurrent with a 6 dB reduction in underwater noise along the shipping lane in the Bay of Fundy, Canada, in 2001.

The E&B infrastructure is located in a well-developed oil and gas area in the North Sea although levels of shipping activity are described as moderate (Section 4.1.1), marine fauna in the area is already exposed to the types of sound that will be generated during the proposed decommissioning. The reported response of animals to received sound has been found to wane with repeated exposure in some studies (Southall, 2007). It is expected that although vessels associated with the decommissioning activities will add to the background noise, the overall impact will not be significant.

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

6.4.2.3 Underwater Cutting

Cutting of underwater structures can be achieved through various methods, which fall largely under the categories of mechanical, thermal, electrochemical and explosive cutting. Mechanical methods use hard cutting tools that produce a sawing or machining action. Examples include hydraulic shears and abrasive water jet cutters. Thermal cutting, e.g. using oxy-arc cutters, involves generating sufficient heat and an oxygen supply in order to burn through steel. Electrochemical techniques use an electrolyte and suitable potential to remove steel.

There is very little information available on underwater sound generated by tools used for underwater cutting operations. Anthony *et al.* (2009) present a review of published underwater noise measurements for various types of diver-operated tools. Several of these are underwater cutting tools, including a high-pressure water jet lance, chainsaw, grinder and oxy-arc cutter. Reported source sound pressure levels were 148-170.5 dB re 1µPa (it was not indicated whether these are rms or zero-peak). It is possible that larger, ROV operated cutting tools could generate louder sound levels but no published data are available.

There is no published information in the response of marine mammals or fish to sound generated by underwater cutting. However, reported source levels are relatively low compared with those generated by vessels and cutting operations are expected to be of short duration, therefore cutting is not likely to cause significant disturbance to marine fauna.

6.4.2.4 Rock Cover

No data are available on what the noise levels generated by the placement of rock cover might be, however it is believed that given the short duration of rock cover activities, there is only likely to be a low impact on cetaceans associated with the noise generated (JNCC, 2008).

6.4.3 Transboundary and Cumulative Impacts

Changes in sound characteristics with distance generally result in exposures becoming less physiologically damaging with increasing distance, although sound can have impacts over longer distances, the most likely receptors being marine mammals and fish. Marine mammals and fish in the area are likely to be habituated to some background noise already due to existing oil and gas installations and the presence of vessels and therefore effects from the noise emitted from the additional decommissioning vessels and the cutting or rock placement activities at the seabed are not expected.

As discussed in Section 4.1.3, there are existing oil and gas assets located within 20 km of the E&B developments. Hence there is a potential for cumulative noise impact due to vessel operations supporting the proposed activities and those supporting other installations in the area. However, the number of vessels anticipated to be present in the area due to these assets is small. Overall the additional noise due to decommissioning is expected to be localised and relatively short term and therefore no significant transboundary or cumulative impacts area expected.

6.4.4 Control and Mitigation Measures

The following control and mitigation measures have been identified for impacts from noise:

- Vessel use will be optimised; and
- Cutting locations and procedures identified in order to minimise number and duration of operations.

6.4.5 Conclusion

Although there are marine mammals and fish in the area around the E&B field, disturbance from noise resulting from decommissioning activities is expected to be low. The greatest potential disturbance is as a result of vessels using DP. However, given that E&B are in an area of established oil and gas activity, marine mammals are likely to be accustomed to similarly sound levels and this reduces the severity of impact.

6.5 Waste Management and Resource Use

6.5.1 Regulatory Requirements

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

Waste legislation for Scotland (The Waste (Scotland) Regulations 2012) controls the generation, transportation and disposal of waste within the European Union and the shipment of waste into and out of the EU. It covers controlled waste, duty of care, registration of carriers and brokers, waste management licensing, landfill, hazardous waste, producer responsibility, packaging waste, end-of-life vehicles, waste electrical and electronic equipment (WEEE) and the trans-frontier shipment of waste.

Whether a material or substance is determined as a ‘waste’ is determined under EU law. The EU WFD (2006/12/EC) defines waste as:

“*any substance or object in the categories set out in Annex 1 of the Directive which the holder discards or intends or is required to discard*”.

Materials disposed of onshore must comply with the relevant health and safety, pollution prevention, waste requirements and relevant sections of the Environmental Protection Act 1990. The waste management assessment should be based on the worst case scenario and follow the hierarchy shown in Figure 6-1, in line with relevant legislation, permits and consents.

Figure 6-1: Waste hierarchy.

Management of radioactive materials is governed under:

- Radioactive Substances Act 1993;
- Trans-frontier Shipment of Radioactive Waste; and
- Spent Fuel Regulations 2008.

The handling and disposal of radioactive waste requires additional authorisation. Onward transportation of waste or recycled materials must also be in compliance with applicable legislation, such as the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009, a highly prescriptive regulation governing the carriage of dangerous goods by road.

6.5.2 Activities (Cause of Impact)

The waste generated as a part of the proposed decommissioning activities will be a combination of both hazardous (special) and non-hazardous wastes.

The inventory of E&B materials and re-use, recycling and disposal aims of material recovered to shore are presented in Table 6-4 and Table 6-5.

Table 6-4: Ettrick and Blackbird materials inventory.

Structures	Total Inventory (te)	Steel (te)	Plastic (te)	Non-Ferrous (te)	Concrete (te)	Rock cover (te)	Other (te)
Ettrick installations	5,058	5,008	3	25	0	0	23
Ettrick pipelines	35,601	1,558	315	3	961	32,627	136
Blackbird installations	349	309	2	6	28	0	5
Blackbird pipelines	45,911	1,667	365	7	877	42,750	246
Total inventory	**86,919**	**8,542**	**684**	**41**	**1,866**	**75,377**	**410**

Table 6-5: Waste stream management processes.

Waste Stream	Removal and Disposal Method
Bulk liquids	All subsea flowline cleaning chemicals and treated flush water was returned to the FPSO for processing and discharge in line with the existing production permits. Fluids remaining in the subsea infrastructure will be discharged on removal. Slops Tanks were discharged in port, at which point the final tank cleaning and gas-freeing activities were completed.
Marine growth	After submersion in the North Sea for over 6 years the risers, jumpers etc. will have accumulated a coating of marine fouling, or marine growth. According to Tvedten (2001) (referenced in BMT Cordah, 2011) the water content of marine growth is typically 70 – 90 % of its total weight. Marine growth starts to dry out as soon as it is lifted out of the sea and therefore the weight of material to be disposed of onshore will depend largely on how much drying out takes place during transportation and if any marine growth will fall off the structure into sea during transit. Where practicable, marine growth will be removed subsea. All remaining marine growth will be removed on the vessel deck or at an onshore disposal facility, in accordance with all applicable guidelines.
NORM/LSA scale	Where any product containing, or suspected to contain, NORM materials is to be recovered to surface, a suitable monitoring and containment regime will be enforced. Any items found to contain NORM during recovery will be contained and sealed and shipped to shore for disposal under the appropriate permits by a Nexen approved contractor under Nexen's and the contractor's management systems. All NORM contaminated items will be decontaminated at an approved facility prior to disposal. All NORM materials will be disposed of at a suitably permitted facility.
Asbestos	Not applicable.
Hazardous wastes	Any hazardous wastes remaining in the recovered infrastructure shall be disposed of under appropriate permit.
Onshore Dismantling Sites	All items of subsea infrastructure removed from the seabed shall be managed by a waste handling company once onshore, with disposal of the decommissioned equipment completed at an appropriately licensed waste management facility (or combination of facilities).

Overall, decommissioning puts resources back into use through re-use of equipment and recycling of materials such as steel. However, where infrastructure is left *in situ* (e.g. trenched and buried flowlines and umbilicals) this material is effectively "lost". This is accounted for under emissions (Section 6.1) which attributed 43 % of the estimated energy usage and associated emissions to the manufacture of new steel to replace recyclable steel left in situ. The fate of the materials to be decommissioned is shown in Table 6-6.

Table 6-6: Inventory disposition.

Structures	Total Inventory (te)*	Planned tonnage to shore (te)	Planned tonnage left in situ (te)*
Ettrick installations	5,058	4,109	949
Ettrick pipelines	2,974	1,345	1,629
Blackbird installations	349	305	44
Blackbird pipelines	3,161	1,035	2,126
Total inventory	**11,542**	**6,794**	**4,748**
**Excludes rock cover*			

6.5.3 Impacts on Receptors

The potential impacts from waste disposal are on the onshore environment and are principally associated with the potential impacts of landfills, typically:

- Use of sometimes scarce landfill space (resource use);
- Degradation of local/regional air quality as a result of onshore transport;
- Potential degradation of the water environment if any leachate is produced by the landfill site and reaches surface water and/or groundwater; and
- Nuisance to the local community from traffic, odour and visual impacts.

Where materials are recycled, impacts will be associated with existing processing plants:

- Degradation of local/regional air quality as a result of transport;
- Degradation of local/regional air quality as a result of plant emissions;
- Degradation of the water environment (surface water and groundwater) associated with any discharges from processing plant; and
- Nuisance to the local community from traffic and visual impacts.

Only existing permitted facilities (under the Environmental Permitting regime (England) or the Pollution Prevention and Control regime (Scotland)) will be used. For those permits to have been approved, the impacts to air, land and water to the local community, will have already been assessed as acceptable. Therefore the use of existing permitted facilities for recycling or disposal is not considered to result in a significant environmental impact.

Marine growth will be dealt with by the selected yard in line with accepted practices. This normally involves landfilling or composting. The major sources of smell following removal of structures can be associated with degradation of marine growth. In recent ROV surveys limited marine growth has been identified on the infrastructure to be removed from the E&B fields and therefore odour is unlikely to be an issue. In addition much of the marine growth will be lost during the cutting and lifting process and during transportation.

6.5.4 Transboundary and Cumulative Impacts

The Aoka Mizu was sailed to Gdansk in Poland for engineering down and all necessary permits for transporting of waste on board were in place prior to sail away. All subsea infrastructure will go to the UK.

6.5.5 Control and Mitigation Measures

Where possible, materials will be recycled or sold and reused. Waste management options will take account of the waste hierarchy (http://wastehierarchy.wrap.org.uk/) shown in Figure 6-1 with reduction in volume of waste being the preferred option. Existing waste disposal routes and contractors will be used where possible.

Segregating materials at source and maintaining this separation between hazardous and non-hazardous waste streams will reduce the amount of material requiring treatment onshore. If hazardous waste is produced it will be pre-treated to reduced hazardous properties or, where possible render it non-hazardous.

NORM contaminated equipment will be handled, transported, stored and disposed of in a controlled manner. Protocols will be in place to ensure that equipment is not released or handled without controls to protect the worker and prevent contamination of the environment.

6.5.6 Conclusion

All regulatory and company procedures for segregation, transport and disposal will be strictly adhered to and only fully permitted facilities will be used for recycling or disposal. The resulting impacts from resource use and waste management are therefore expected to be low.

6.6 Accidental Events

6.6.1 Activities (Cause of Impacts)

The following decommissioning activities have been identified as having the potential to result in an accidental release of hydrocarbons:

- Well blowout; and
- Vessel collision resulting in a spill of diesel

Each well is fully suspended with two proven barriers to the environment and all tree structures are overtrawlable. Therefore, in terms of risk of a well blowout scale event, the “likelihood” remains low, the same as under normal operating conditions. In addition, the reservoirs are depleted, each well has been bullheaded to push hydrocarbon away from the wellbore and back into the reservoir, and no lift force is being applied so the wells are not under pressure. As a result, the “consequence” of a large scale release, in terms of volume and rate from the wells, is greatly reduced compared to normal operations which lowers the overall risk. For the purposes of this EIA it is realistic to assume that in the event of a worst case scenario, where for example a Xmas Tree is ripped off and the completion tubing and Sub Surface Safety Valve are damaged and lose integrity, unconstrained flowrates, as declared in the OPEP, would not occur or persist. The volumes of hydrocarbons released from any of the wells during P&A activities is therefore considered to be minimal.

No modelling specific to the decommissioning work has been carried out but the scenarios given in the OPEP for the E&B fields have been used to determine the likely behaviour of oil and diesel following a spill. It should be noted that the well blow out modelled in the OPEP (Nexen, 2016b) is considerably larger than anything that would be expected at this stage of field life.

The OPEP (Nexen, 2016b) includes Oil Spill Contingency and Response (OSCAR) modelling for the following worst case scenarios:

1. Well blowout resulting in loss of 12,439 m^3 of crude over a 120 day period; and
2. Vessel collision resulting in loss of 3,550 m^3 of diesel over a 1 hour release period.

Ettrick and Blackbird crude have similar properties. In the event of a spill to sea, the crude will remain afloat on the sea surface. The crude has a wax content of approximately 6 % which indicates the crude will be highly vicious and persistent. Weathering models on Ettrick crude suggest that the crude will rapidly lose approximately 32.3 % volume from the sea surface by evaporation within the first few hours of a spill at sea. A total of 45.6 % volume will eventually be lost by evaporation over the following 24 - 48 hours.

Diesel has very high levels of light hydrocarbons and therefore evaporates quickly on release. The low asphaltene content prevents emulsification reducing its persistence in the environment.

Stochastic modelling (taking into account prevailing weather conditions to determine a probability of surface oiling) of Scenario 1 indicates potential areas of beaching occurring along the UK coast. The highest probability of beaching is in the Grampian region, ranging from 70-80 % probability (from December to February) to 30-40 % probability (from March to August). The time until initial beaching in Grampian is from two to four days. Beaching is also predicted on the coasts of neighbouring member states, with a maximum probability of beaching of 20-30 % on the coast of Norway more than 30 days after release.

Stochastic modelling of the worst case diesel spill (Scenario 2) indicates that the diesel has a probability of 1 to 10 % of beaching in the Grampian region depending on the season. No beaching is predicted in any other member state. There is a 1 % to 5 % probability of the diesel crossing the UK/Norway median line in June to August. The modelling shows the diesel taking 7 to 10 days to reach the median line following release.

Given that the size of the potential worst case spill under current conditions would be considerably less than for the well blow out scenario the extent of surface oiling would also be considerably reduced.

6.6.2 Impacts on Receptors

A large scale spill of hydrocarbons could impact all parts of the marine ecosystem and affect other users of the sea. Fish, marine mammals and seabirds are the most likely groups to be impacted. The severity of the impact would depend on the variety and numbers of vulnerable species present at the time of the release and during the presence of the hydrocarbon on the sea water surface.

Seabirds are vulnerable to hydrocarbon surface pollution which can cause direct toxicity through ingestion or hypothermia due to the loss of ability to maintain waterproof feathers. Seabirds are most vulnerable during the moulting season when they become flightless and spend large amounts of time on the water surface, and following the end of the breeding season, when certain birds (notably auks) disperse away from coastal breeding colonies and are found in high numbers offshore. As noted in Section 3.3.5, annual seabird vulnerability is considered to be high overall within the E&B fields.

Cetaceans are generally very mobile, reducing their vulnerability to contamination although disruption to their social functions of care and reproduction may occur. Densities of cetacean in the vicinity of the E&B fields vary by species but are most frequently sighted in the summer months (see Section 3.3.4). Densities of white-beaked dolphin and harbour porpoise appear to be relatively high in the summer months.

Fish spawning (including whiting, lemon sole and Norway pout) occurs throughout the year with peaks in the spring and summer months within the E&B area. These spawning grounds form a relatively small part of very extensive spawning grounds found within the North Sea (Section 3.3.3). Fishing activity within the area is considered low to moderate (Section 4.1.2).

Any partitioning of diesel or crude oil into the sediment could impact benthic organisms but is likely to be very limited as the bulk of it will evaporate and disperse without reaching the seabed (depths of 110 m). The amount that remains in the sediment depends on the sediment type, with more partitioning to silty sediments compared to sandy sediments. The seabed around E&B fields is predominantly sandy and therefore less likely to retain oil.

Any significant spill of oil is likely to impact on both offshore and onshore protected sites. The nearest onshore protected site is the Buchan Ness to Collieston Coast Special Protection Area, which is c.70 km southwest of the developments and is of importance as a nesting area for a number of seabird species (gulls and auks). These birds feed outside the SPA in the nearby waters, as well as more distantly and would therefore be impacted by a well blowout.

The nearest Nature Conservation Marine Protected Area to the E&B developments is Turbot Bank c.40 km south of Block 20/2. The Turbot Bank NCMPA is located off the east coast of Scotland, and lies within an area of sandy sediment. It includes part of the shelf bank and mound known as ‘Turbot Bank’, an area of importance for sandeels where they live buried in the sand for months at a time.

Given the low likelihood of the release of a large volume of diesel and the short duration the diesel is predicted to remain on the surface combined with the mitigation and control measures in place, the significance of the impact on surface and near-surface dwelling ecosystems and species has been assessed as **low**.

A well blowout of the size modelled in the OPEP is considered remote, therefore although the consequence would be classed as Major, the overall risk is determined to be low (see Table 5-1). An accidental spill of diesel is considered to be of low risk.

6.6.3 Transboundary and Cumulative Impacts

A potential diesel spill would be relatively unlikely to cross the UK / Norwegian median line (up to 10 % probability) and therefore transboundary impacts are not expected from a diesel spill.

In the unlikely event of a major oil spill there is the potential for oil to cross the UK / Norwegian median line. Overall, however, the risk to the environment is considered to be low (see previous section) given the very low likelihood of such an event occurring.

6.6.4 Control and Mitigation Measures

Nexen has well developed procedural controls in place to minimise the likelihood of releases and to mitigate the impacts of releases should they occur, as set out in the Ettrick area OPEP (Nexen, 2016b). Nexen have a contract with Oil Spill Response Limited (OSRL). They would be mobilised in the event of a larger spill in order to provide trained personnel, equipment and additional logistics.

The OPEP also sets out the requirements for staff competency and training. Emergency Control Exercises are conducted every three years.

Each vessel used during decommissioning will have its own Shipboard Oil Pollution Emergency Plan (SOPEP) developed within the requirements of Regulation 37 of MARPOL Annex 1 (MARPOL, 1973). Only vessels which meet Nexen's assurance standards will be used and all vessels will be assessed prior to the start of the contract. Risks associated with simultaneous operations will be assessed before the decommissioning activities are carried out.

6.6.5 Conclusions

The measures that are in place in the E&B fields are considered effective in minimising the risk of a large oil release during decommissioning activities to ALARP.

6.7 Socio-Economic Impacts

6.7.1 Activities (Cause of Impacts)

The potential sources of impact on socio-economic activities are:

- The use of vessels for the decommissioning activities;
- Handling and treatment of waste onshore; and
- The requirement for legacy surveys.

6.7.2 Impacts on Receptors

The socio-economic receptors which could be impacted as a result of the decommissioning operations are:

- Employment;
- Communities local to onshore sites;
- Commercial fishing; and
- Shipping.

During the various phases of decommissioning, specialist expertise will be required, particularly from the engineering sector, and work will be created both within Nexen and contractor organisations. In addition, the requirement for additional vessels to support the decommissioning activities will boost employment as will the cleaning, engineering down and recycling of any items returned to shore. These jobs are relatively short term, compared to the jobs lost from operation of the E&B fields, therefore there is a small negative impact on employment overall.

Cleaning, engineering down and dismantling of the structures when brought onshore have the potential to cause disturbance to the local community. Such disturbance could take the form of increased noise and vibration, odour, light, dust, gaseous emissions and visual disturbance. However, as the facilities being considered for the work regularly undertake work of this kind, the onshore activities associated with decommissioning of the E&B fields are unlikely to represent an increase in current impacts to the community.

The potential socio-economic impacts on commercial fishing in the area include the physical presence of the decommissioning vessels causing potential interference to fishing activities

and damage to or loss of gear as a result of subsea obstructions left *in situ*, posing potential snagging risks.

During the decommissioning project, there will be potential for navigational conflicts between fishing vessels and decommissioning vessels transiting to and from the site which could result in fishing vessels having to alter their towing direction. Nexen will continue to liaise with the SFF. As many of the decommissioning activities identified will take place within existing 500 m exclusion zones (around E&B) and given the short duration of the planned activities, the use of appropriate navigational lights and warning systems and the continued communication with SFF, the impact on commercial fisheries is considered low.

Once decommissioning has been completed, there is the potential for fishing gear to snag on subsea obstructions which have been left *in situ*. The SFF were involved in the options screening and comparative assessment process and decommissioning options have been selected to take their views into account. Where trenched pipelines are being left in situ rock cover will be used at the pipeline ends to reduce snagging hazard. Recovery of all mattresses is the base case for the decommissioning works.

Following completion of the decommissioning activities, Nexen will commission a debris clearance sweep using specially designed trawling equipment. Any debris retrieved will be returned to shore for recycling/disposal. Following this remedial work, the area will then be trawled with fishing gear relevant to the area to ensure no snag hazards remain. The results of the sweeps and a copy of the Seabed Clearance Certificate issued by the verifier will be submitted to BEIS along with the Decommissioning Closeout Report.

Following decommissioning, the 500 m exclusion zones around the DTB and the E&B drill centres, will be relinquished and the area will be made available for fishing.

As most of the decommissioning activities will be carried out within existing exclusion zones, the potential impacts of the decommissioning vessels on existing shipping is considered low.

6.7.3 Transboundary and Cumulative Impacts

No transboundary impacts on shipping, fishing or employment are likely given that the UK /Norway median line is *c* 142 km away from the E&B fields. The cumulative impact of vessels from decommissioning activities with the existing oil and gas assets in the area is considered low given the relatively low levels of shipping and fishing effort in the vicinity.

6.7.4 Control and Mitigation Measures

The key mitigation in relation to minimising impacts on fishing is through the selection of appropriate decommissioning options for all seabed infrastructure. This was undertaken in consultation with SFF and Nexen will continue to consult with SFF throughout the decommissioning works. Over-trawlable studies will be undertaken to check for any potential snagging hazards.

6.7.5 Conclusion

Overall socio-economic impacts in relation to shipping, fishing and employment resulting from the decommissioning activities are considered to be low.

7.0 CONCLUSIONS

The EIA process presented in this document considers the impact of the planned activities associated with the decommissioning of the E&B fields. The impact was determined by considering the duration/frequency of each of the planned activities and environmental/social baseline to determine the overall level of impact as either low, medium or high. All planned events were considered to be of low impact.

Nexen will follow routine environmental management activities including contractor vessel assessments and legal requirements to report discharges and emissions, such that the environmental impact of the decommissioning activities will be minimised. Following the EIA process it can be concluded that activities associated with the decommissioning of the E&B fields are unlikely to significantly impact the environment or other sea users provided that the proposed mitigation and control measures are put in place.

7.1 Energy Use and Atmospheric Emissions

The principal energy use and generation of emissions to air local to the E&B developments will arise from fuel combustion for propulsion and power generation by the vessels required for the activities. These emissions will include components which have the potential to contribute to global warming, acid rainfall, dry deposition of particulates and photochemical pollution or cause impacts on local air quality. It is expected that impacts will be low significance as they will be short term.

The energy usage from the decommissioning of the E&B infrastructure is estimated to be 710,827 GJ direct (vessel use) and 179,810 GJ indirect requirements (manufacture of new materials to replace those decommissioned in situ and those recovered should none of them be reused).

Total direct CO_2 emissions generated by the proposed decommissioning activities comprise emissions from vessels. The CO_2 emissions from vessels equate to 0.53 % of UK domestic shipping emissions 2014. Emissions to atmosphere from the decommissioning activities are unlikely to significantly contribute to greenhouse gas emissions or global warming impacts.

Standard mitigation measures to optimise energy usage by vessels will include operational practices and power management systems for engines, generators and any other combustion plant and planned preventative maintenance systems for all equipment for peak operational efficiency.

7.2 Discharges to Sea

There is the potential for small quantities of residual chemicals and hydrocarbons to be released into the water column from lifting of subsea infrastructure and from vessels used for decommissioning. The seabed and the water column are the primary receptors. Mitigation includes a successful post-COP deoiling programme, chemical selection processes, any permitting of hydrocarbon and chemical discharges and strict vessel operating procedures. All of these impacts will be localised and short term given the highly dynamic environment around E&B

7.3 Solid Deposits on the Seabed and Disturbance to the Seabed

The principal sources of seabed disturbance associated with the E&B decommissioning activities concern the removal of structures, spools, mattresses and grout bags, rock dumping of flowline ends, cutting operations and anchoring of the semi-submersible drilling rig. These activities will result in the displacement of substrate and the suspension and subsequent settlement of sediment. Standard measures to control disturbance include operational planning and equipment selection.

The species and habitats observed in the vicinity of the E&B fields are relatively widespread throughout the CNS and the area anticipated to be impacted represents a very small percentage of the available habitat. Furthermore, all disturbed sediments are expected to recover rapidly though recruitment from adjacent undisturbed areas. In addition there were no MDAC features identified in the surveys carried out in the area of the E&B developments.

In summary, due to the localised and relatively short duration of the decommissioning activities, and with the identified control and mitigation measures in place, the overall significance of the impact of seabed disturbance as a result of the decommissioning of E&B fields is considered to be low.

7.4 Underwater Noise

Although there are marine mammals and fish in the area around the E&B field, disturbance from noise resulting from decommissioning activities is expected to be low. The greatest potential disturbance is as a result of vessels using DP. However, given that E&B are in an area of established oil and gas activity, marine mammals are likely to be accustomed to similarly sound levels and this reduces the severity of impact.

7.5 Waste Management and Resource Use

All regulatory and company procedures for segregation, transport and disposal will be strictly adhered to and only fully permitted facilities will be used for recycling or disposal. The resulting impacts from resource use and waste management are therefore expected to be low.

7.6 Accidental Events

The measures that are in place in the E&B fields are considered effective in minimising the risk of a large oil release during decommissioning activities to ALARP.

7.7 Socio-Economic Impacts

Overall socio-economic impacts in relation to shipping, fishing and employment resulting from the decommissioning activities are considered to be low.

7.8 Overall Conclusion

This EIA has assessed the impacts and risks associated with the proposed decommissioning activities in the context of the environment within which the E&B fields and infrastructure are situated. With implementation of the proposed mitigation measures, the environmental impact of the removal of the facilities is likely to be temporary with regard to

disturbed seabed within the project footprint. Recovery of the ecology is expected to begin immediately on completion of the activities. Rock placed over cut pipe ends and short lengths of exposed pipelines to make the seabed safe for fishing will have a long-term presence, but will be very limited in extent. The proposed approach to decommissioning the E&B facilities will remove man-made structures from the seabed, leaving it in a condition suitable for re-colonisation by local species and safe for fishermen.

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9.0 APPENDIX A ENVID TABLES.

Subsea Recovery							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
Physical presence	Navigation hazard caused by vessel	Interference with fishing, offloading tankers and supply vessels. Disturbance to birds/cetaceans.	B	1	Low	Manifold and FPSO 500 m safety zones maintained. Consultation with SFF. Kingfisher Bulletin. Notice to Mariners. SimOps plan in place. Permit to work required. Optimise vessel use.	Low
	Infrastructure (e.g. pipelines, and rock cover) left in place: long term fate of materials	Non-biodegradable materials. Hazard to sea users.	C	1	Low	Trenched and buried/rock dumped. Seabed clearance survey carried out by SFF. Monitoring program.	Low
Emissions to air	Vessel fuel combustion emissions (CO_2, CO, SOx, NOx, etc.)	Deterioration of local air quality and contribution to climate change. Minor contribution to atmospheric pollution (compared to overall activity in the North Sea).	E	1	Medium	Conform to MARPOL NOx and SOx limits. Optimise vessel use.	Low

Subsea Recovery							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
	Depressurisation of gas export line: flaring/venting resulting in release of CH_4, CO_2, SOx, NOx, VOC, NOx and particulates	Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	E	1	Medium	Covered by flaring consent.	Low
Discharges to sea	Chemical purge into production header at trees; bulk deoiling and flushing of the production and test lines (discharge to sea or at Norwegian port)	Local water quality deterioration, impact on marine flora and fauna.	B	2	Low	Variation to offshore production chemical permit to capture use and discharge. Least harmful chemicals selected (subject to chemical risk assessment).	Low
	Flushing of lines associated with E&B drill centres for bullheading	Smothering of benthic organisms, suspended solids, and local water quality deterioration.	A	1	Low	MEG is a PLONOR chemical and use and discharge will be covered on chemical permit. Keep within maximum operating pressure of xmas tree.	Low
	Flushing WI systems with inhibited seawater	Follows normal operational procedures, No significant aspects identified.					
	Flushing of umbilicals: potential discharge via topsides	Smothering of benthic organisms, suspended solids, and local water quality deterioration.	A	1	Low	Variation to offshore production chemical permit to capture use and discharge. Least harmful chemicals selected (subject to chemical risk assessment). Injection downhole may be possible.	Low

Subsea Recovery							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
	Subsea disconnections: potential discharge of oil and chemicals	Local water quality deterioration, impact on marine flora and fauna.	D	1	Low	Chemical use and discharge covered in permit. Any discharges will be subject to chemical risk assessment.	Low
Seabed disturbance	Recovery of subsea infrastructure and temporary storage on seabed: de-burial, wet storage, potential impact of buoy after release, suction cans, dredging (e.g. around base of SSIV), clump weights and transponders	Localised impact on benthic communities. Environmental surveys in the area identified no Annex I or II habitats or species.	D	1	Low	Rapid recovery of seabed. Activities covered on EIA Justification and Marine Licence.	Low
	Additional deposits.	Change of habitat for marine flora and fauna.	C	1	Low	Deposits covered in Marine Licence.	Low
	Disturbance of old cuttings piles.	Localised impact on benthic communities. Environmental surveys in the area identified no Annex I or II habitats or species.	B	1	Low	Captured in EIA Justification and pre-decommissioning surveys.	Low

Subsea Recovery							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
Underwater noise	Cutting (driven piles will be cut), DP, diver tools. Use of explosives unlikely but not ruled out.	Generates elevated sound levels which can affect the behaviour of fish and marine mammals in the area. If explosives are used there is the potential for injury to fish and marine mammals.	E	1	Medium	Assessed in EIA Justification. Noise considered below action threshold unless explosives are used. If explosives are used a full impact assessment and adherence to JNCC protocol for use of explosives (JNCC, 2009).	Low
	Vessels.	Disturbance of marine mammals and fish.	D	1	Low	Minimise use of vessels Noise considered below action threshold.	Low
Waste	Radioactive waste	Radioactive waste disposal onshore. Use of landfill. Additional emissions from transport. Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	C	2	Low	SEPA permit for accumulation and disposal of radioactive waste (Radioactive Substances Act, 1993). Waste management plan will provide a disposal chain.	Low

Subsea Recovery							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
	Disposal of subsea infrastructure	Impacts associated with onshore disposal are dependent on the nature of the site or process. Landfills – land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	E	1	Medium	Follow the waste hierarchy to minimise amount to landfill. Scrap metal wastes to be properly segregated for recycling / disposal onshore. Recycling of structures where possible.	Low
Societal impacts	Use of landfill	Use of a finite resource.	C	1	Low	Follow the waste hierarchy to minimise amount to landfill.	Low
Accidental events	Methanol or MEG discharges to sea	Local water quality deterioration, impacts on marine flora and fauna.	B	2	Low	Flushing and preservation regime to avoid unplanned discharges. Compatibility study on chemicals.	Low
	Damage to pipelines from corrosion or dropped objects resulting in discharge of small volumes of hydrocarbons	Local water quality deterioration, impacts on marine flora and fauna.	B	2	Low	Flushing and preservation regime to avoid unplanned discharges. Pipelines buried and rock dumped. Annual pipeline inspection. OPEP will be in place.	Low

Well Plug and Abandonment							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
Physical presence of drilling rig/well intervention vessel	Navigation hazard	Interference with fishing, offloading tankers and supply vessels. Disturbance to birds/cetaceans.	B	1	Low	Manifold and FPSO 500 m safety zones maintained. Consultation with SFF. Kingfisher Bulletin. Notice to Mariners. SimOps plan in place. Permit to work required. Optimise vessel use.	Low
Emissions to air	Exhaust emissions from abandonment operations (i.e. burning of diesel)	Emissions to atmosphere result in a minor contribution to global warming, acidification and photochemical smog (compared to overall activity in the North Sea).	E	1	Medium	Adherence to good operating practices. UK and EU Air Quality Standards not exceeded.	Low
Discharges to sea	Reservoir conditioning (bullheading): potential release of small volumes of MEG with traces of oil	Large volumes of MEG can pool on the seabed and cause smothering of benthic organisms, suspended solids, local water quality deterioration.	A	1	Low	MEG is a PLONOR (Pose Little or NO Risk) chemical and use and discharge will be covered on chemical permit. Keep within maximum operating pressure of Xmas tree.	Low
	Permanent barrier setting: potential discharges of cement and chemicals	Short term impact on water quality and localised smothering of seabed and associated biota.	C	1	Low	Least harmful chemicals selected (subject to chemical risk assessment). Use and discharge will be covered on chemical permit. Cement use will be minimised by good operating practice. Excess dry cement will be shipped to shore and not discharged to sea.	Low

Well Plug and Abandonment							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
	Circulation and perforation: release of wellbore clean-up fluids contaminated with residual OBM	Minor loss of seabed habitat and smothering of benthic organisms from suspended solids. Environmental surveys in the area identified no Annex I or II habitats or species.	C	1	Low	Use and discharge will be covered on chemical permit.	Low
Seabed disturbance	Anchoring of vessels	Anchors, chains and chain slap prior to tensioning can cause anchor scars to sea bed. Small area of seabed impacted. Environmental Surveys in the area identified no Annex I or II habitats or species.	C	1	Low	Anchoring patterns and mooring plans formulated in advance.	Low
	Removal of subsea structures. Cut casing below seabed and pull tree and wellhead. Temporary wet storage if required.	Small impact on seabed. Discharge of grit.	E	1	Medium	Covered on Marine Licence.	Low
Underwater noise	Cutting (driven piles will be cut), DP and diver tools.	Generates elevated sound levels which can affect the behaviour of fish and marine mammals in the area.	E	1	Medium	Assessed in the Environmental Impact Assessment. Noise considered below action threshold.	Low

Well Plug and Abandonment							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
Waste	Cut and recover tubing: radioactivity.	Potential discharge of small quantities of radioactive waste may have impact on water quality and marine flora and fauna.	C	1	Low	Scottish Environment Protection Agency (SEPA) permit for accumulation and disposal of radioactive waste. Cleaning of waste to allow disposal of small quantities in line with permit conditions and the Radioactive Substances Act, 1993.	Low
	Cut and recover tubing: limited resource	Radioactive waste disposal onshore. Use of landfill. Additional emissions from transport. Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	C	2	Low	SEPA permit for accumulation and disposal of radioactive waste (Radioactive Substances Act, 1993). Waste management plan will provide a disposal chain which will include possible recycling of the steel.	Low

Well Plug and Abandonment							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
	Disposal of subsea infrastructure	Impacts associated with onshore disposal are dependent on the nature of the site or process. Landfills – land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants- nuisance, atmospheric emissions, potential for contamination of sites.	E	1	Medium	Follow the waste hierarchy to minimise amount to landfill. Scrap metal wastes to be properly segregated for recycling / disposal onshore. Reuse of structures where possible.	Low
Societal impacts	Disposal of waste materials: transport and use of landfill	Use of a finite resource.	C	1	Low	Follow the waste hierarchy to minimise amount to landfill.	Low
Accidental events	Accidental release of old OBM	Loss of seabed habitat and smothering of benthic organisms from suspended solids. Environmental surveys in the area identified no Annex I or II habitats or species.	C	1	Low	Approved Oil Pollution Emergency Plan (OPEP) in place.	Low

Well Plug and Abandonment							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
	Permanent barrier failure: potential release of hydrocarbons	Damage to commercial fisheries, sediment and water quality impairment and release of atmospheric emissions. Impacts on marine flora and fauna.	A	3	Low	The design and integrity of cement plugs will adhere to Nexen's well abandonment policy and will follow UKOOA guidelines for well abandonment and suspension. Reservoir sub-hydrostatic. Wells bullheaded to inhibit release of hydrocarbons. Legal guidelines requiring a minimum of two barriers adhered to. All barriers tested. Fully rated and tested blind flange between all wells and environment, double block and bleed. Annual ROV inspection. Guard vessel stationed at field provides 24 hour surface monitoring. Oil spill contingency plan. WIMS (Well Integrity Management System).	Low
	Permanent barrier setting: unplanned discharge of out of spec cement	Loss of seabed habitat and smothering of benthic organisms from suspended solids. Environmental surveys in the area identified no Annex I or II habitats or species.	C	1	Low	Personnel training. Preparation of cement unit.	Low

Post –Decommissioning Survey							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
Physical presence of survey vessels	Navigation hazard	Interference with fishing, offloading tankers and supply vessels. Disturbance to birds/cetaceans.	B	1	Low	Manifold and FPSO 500 m safety zones maintained. Consultation with Scottish Fishermen's Federation. Kingfisher Bulletin. Notice to Mariners. SimOps plan in place. Permit to work required. Optimise vessel use.	Low
Emissions to air	Vessel fuel combustion emissions (CO_2, CO, SOx, NOx, etc.)	Deterioration of local air quality and contribution to climate change. Minor contribution to atmospheric pollution (compared to overall activity in the North Sea).	E	1	Medium	Conform to MARPOL NOx and SOx limits. Optimise vessel use.	Low
Discharges to sea	Oily water; (machinery space drainage, maximum 15 ppm oil in water)	Local water quality deterioration; impact on marine flora and fauna.	E	1	Medium	MARPOL compliant. Optimise vessel use.	Low
	Ballast water	Non-native species introduced to environment.	A	1	Low	Ballast water management system in place.	Low

Post –Decommissioning Survey							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
Seabed disturbance	Survey grab samples	Small area of seabed impacted. Environmental Surveys in the area identified no Annex I or II habitats or species.	D	1	Low	Sediments relatively clean. Optimise sampling design.	Low
	Anchoring of vessels	Immediate disturbance and potential smothering of seabed and benthic faunal communities. Environmental Surveys in the area identified no Annex I or II habitats or species.	C	1	Low	Anchoring patterns and mooring plans.	Low
Underwater noise	Vessels and survey equipment	Generates elevated sound levels which can affect the behaviour of fish and marine mammals in the area.	D	1	Low	Covered by Marine Survey permit.	Low
Waste	General operational waste from vessels including waste oil, scrap metal, oily cloths, etc.	Effects associated with onshore disposal are dependent on the nature of the site or process. Landfills - land take, nuisance, emissions (methane), possible leachate, limitations on future land use. Treatment plants - nuisance, atmospheric emissions, potential for contamination of sites.	D	1	Low	Compliance with MARPOL requirements. Vessel owner to minimise all wastes. Waste Management Plan. Waste minimisation and supply chain management.	Low
	Domestic sewage; grey and black water macerated to <6 mm prior to discharge	High Biochemical Oxygen Demand (BOD) may have immediate local impact on water quality (deoxygenation), resultant impacts on marine flora and fauna.	E	1	Medium	MARPOL compliant. Optimise vessel use.	Low

Post –Decommissioning Survey							
Aspect	**Source**	**Impact**	**Likelihood**	**Severity**	**Risk**	**Mitigation / Prevention/ Control**	**Residual Risk**
	Food waste	Potential food chain impacts through introduction of an anthropogenic food source.	E	1	Medium	MARPOL compliant. Optimise vessel use.	Low
Accidental events	Leaks to sea of hydraulic fluid from Remotely Operated Vessels (ROV) (water-based)	Local water quality deterioration, impact on marine flora and fauna.	C	2	Low	Maintenance routine carried out by contractor.	Low
	Oil spill due to vessel collision	Water quality deterioration, impact on marine flora and fauna. Immediate oxygen demand on receiving water with consequential impacts on marine fauna.	A	3	Low	Emergency response plans in place including Shipboard Oil Pollution Emergency Plan (SOPEP) for vessel (required under Merchant Shipping Regulations). Manifold and FPSO 500 m safety zones maintained. Consultation with SFF. Kingfisher Bulletin. Notice to Mariners. SimOps plan in place. Permit to work required. Optimise vessel use.	Low